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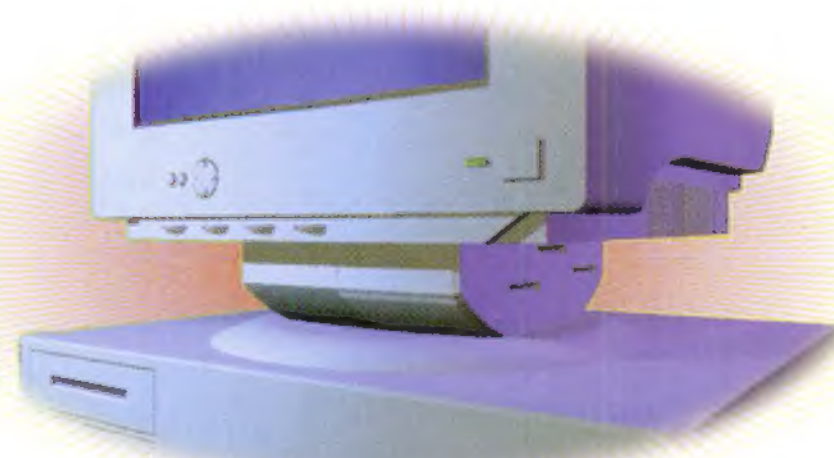
SPECIAL ISSUE

The 100 Most Influential Companies
Our Exclusive Ranking of the
Leaders in Personal Computing



Service & Reliability
The Best and the Worst

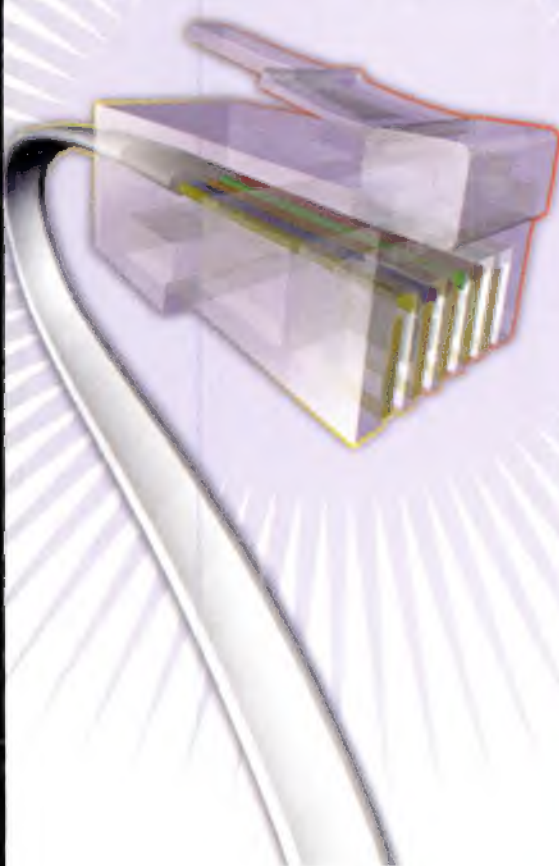
How To Choose



DESKTOPS

The Perfect

NETWORKS



PORTABLES

PC

**AND
MORE!**



NEC MultiSync Monitors E and A Series

THE MONITORS THAT ARE BEST FOR CHRISTIAN'S NEEDS can also speak to yours. Introducing the NEC MultiSync® Enterprise and Advanced Series, the monitors for people looking for superior, lifelike images. And the monitors for people who want the kind of flexibility that super high resolutions and refresh rates ensure.

OSM™ (On-Screen Manager) controls make image adjustments easy. Plus, select Enterprise monitors feature CROMACLEAR™ CRT, for unparalleled focus, contrast and intense color saturation. And, of course, the industry-leading NEC warranty includes 3 years parts, labor and CRT.

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MULTISYNC® MONITORS

	Max Res	Bandwidth	CRT Type	Pitch
A500	1280 x 1024 @ 60Hz	112MHz	Dot Trio	0.28mm dot
A700	1280 x 1024 @ 65Hz	119MHz	Dot Trio	0.28mm dot
E500	1280 x 1024 @ 65Hz	119MHz	CROMACLEAR	0.25mm mask
E700	1600 x 1200 @ 65Hz	177MHz	CROMACLEAR	0.25mm mask
E1100	1600 x 1200 @ 65Hz	177MHz	Dot Trio	0.28mm dot



Expect more. Experience more.

NEC

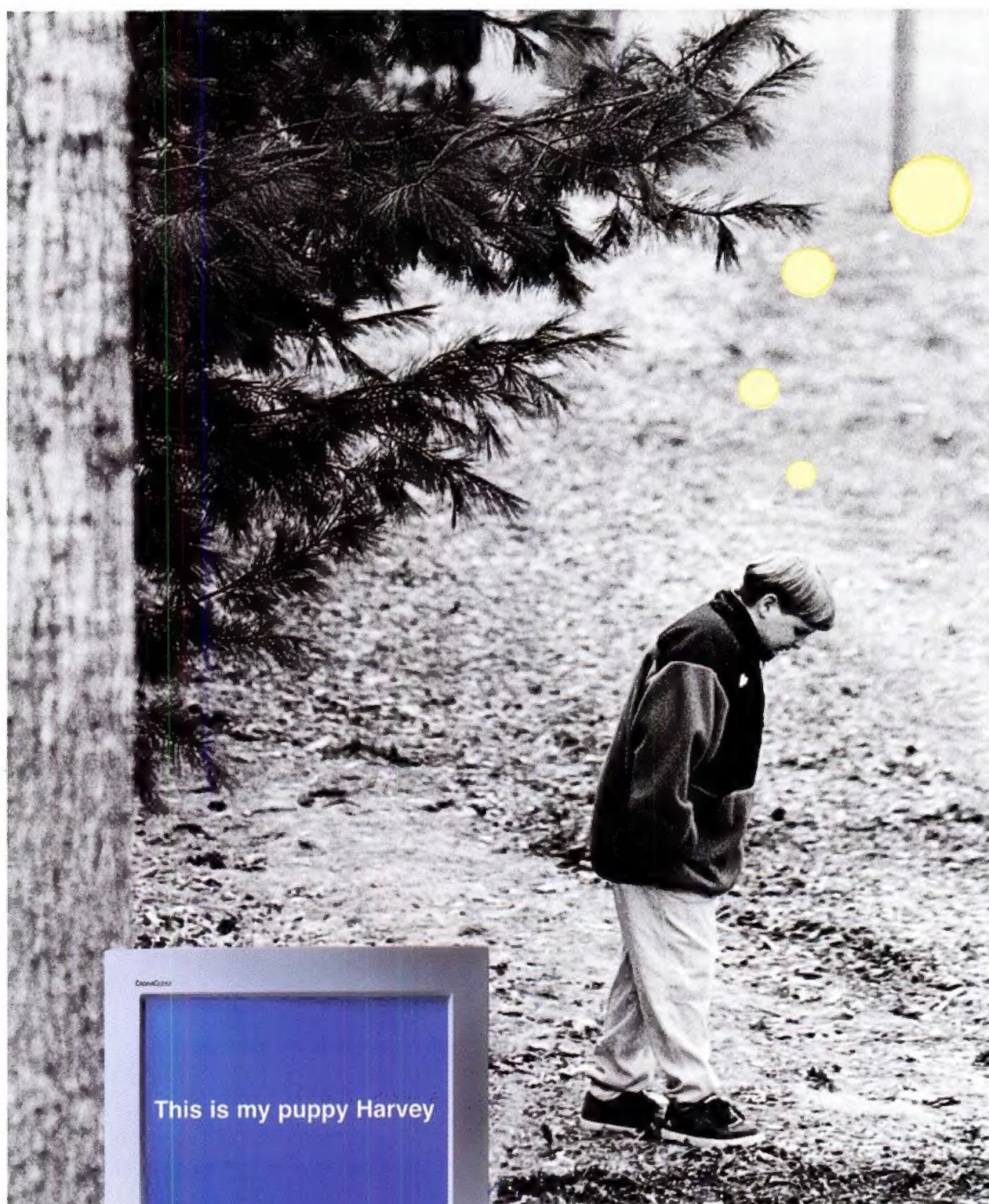
2 A TEACHER DISCOVERED that Christian would respond to images from his life. She put visual cues to the story of his new puppy on a special keyboard.

3 THE MONITOR BECAME HIS VOICE. With it he makes class reports and conversation. With it, Christian, 11, has been in the regular Osterville, MA public school since first grade.



4 WITH THE PICTURES, HE MADE SENTENCES. With the sentences, he made friends. Christian's monitor is the window between his non-verbal world and the speaking world of his friends. Through it, he teaches them many things.





This is my puppy Harvey

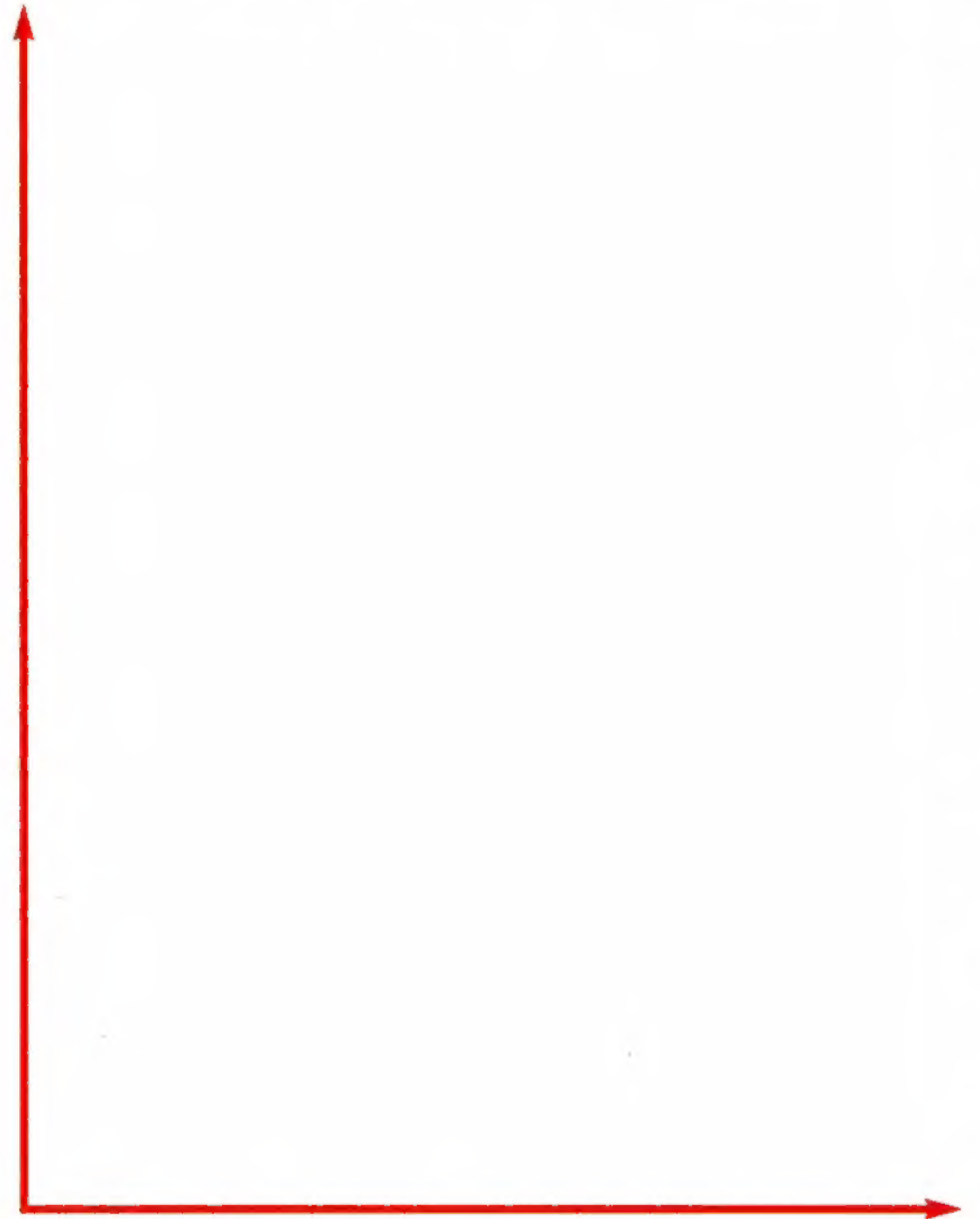
NEC Multisync E700

Until he found this window.

- 1** THIS IS CHRISTIAN.
He can see, hear, feel, touch, but
he cannot speak. He was born with
autistic tendencies that cut him off
from the world around him.



**Christian Murphy was non-verbal.
He lived with a wall between himself and the world.**





CIRCLE 157 ON READER SERVICE CARD



Inbox



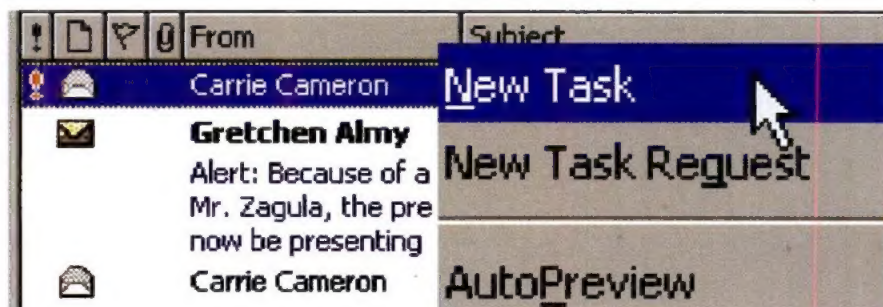
Calendar



Journal



Tasks



Contacts



Microsoft Office 97/now/
it's going to be rea
to stay disorganized.



Address Book



Plan a Meeting

Goodman, JaeE-mail: jae@wk.com**Lilly, Kim**E-mail: kimlil@wk.com**Rotondo, Matt**E-mail: mattr@wk.com**Smith, Ken**

10 am

☀ Production Meeting (5th floor conf)

11 00

☀ "where we are headed" meeting (my office)

12 pm

☀ Lunch with client (TBD)

1 00

Meeting with Lori Newman



Ily, really hard

Some people are inclined to neatly arrange, file, cross-reference and deploy strategic bits of information, like what's-his-name, the guy who sent you the e-mail about the thing on Tuesday...or Wednesday. Well, here's good news for the highly with-it and the chronically disorganized alike: the [new Microsoft® Outlook™ 97 desktop information manager](#). It's part of [new Microsoft Office 97](#), and it's here to help you get organized (or, as the case may be, way more organized). Outlook puts your [e-mail, electronic scheduling, "to-do" lists and contacts in one cozy interface](#). It helps you do smart things, like preview the first three lines of your e-mails to quickly separate news from junk. And you can easily [share, link and move information](#); for instance, drag an e-mail onto the contacts icon and a new contact file is automatically created for you. Now, that's functionality. Want to know more? Block out a little time to visit our Web site.

Where do you want to go today? www.microsoft.com/office/**Microsoft®**

The Influencers



A few issues ago, we celebrated our fifteenth anniversary by looking back at how far the PC industry has come, and looking forward to the technologies that we expect to shape the industry over the next few years. The PC revolution has come a long way, but we all think it has a long way to go.

One question on everyone's mind is where the technology will take us. Of course, we will continue to see improvements in the products we now use. Technology means that desktops, servers, and portable computers will get faster, better, and less expensive. Not bad.

But we may also see radically new visions of products that take us in brand-new directions, incorporating such things as wireless communications, intelligent agents, and voice recognition. PC technology is finding its way into communications and entertainment products. All sorts of combinations are possible in the future.

More important, what will we do with this technology? Computer technology can be an instrument of democracy, extending decision making to people who otherwise have no such power. Or it can be an instrument of control, leading us into an era of Big Brother, where computers track every possible fact about every living person. It can help us stay in contact with friends and relatives all over the world. Or it can make us all seem like interchangeable numbers.

A lot depends on how we use this technology. Now it is used for both good and bad in our businesses, our schools, and our government.

So who will determine which way the technology will go and how we will use it?

A partial answer derives from our list "The *PC Magazine* 100," which represents *PC Magazine's* rankings of the 100 most influential companies in the computer industry (page 213). Our editors, writers, and Labs staff spent weeks debating the order of these companies. We certainly didn't all agree, and I'm looking forward to hearing what readers think.

Some of these companies provide core technology, such as operating systems, microprocessors, and PC

components and peripherals. Some package together the technology into complete systems. Some sell applications software for use on your personal computer, on a network, or on the Internet. Some sell hardware and software for tying things together in local or wide area networks. Some publish magazines, run trade shows, or offer influential market research. All of these

companies influence the direction in which technology will travel and how we will use it.

However, these companies are not the only entities that have a role in determining where technology will take us. For instance, the government will have a role—for better or worse.

When all is said and done, the opinions of the PC hardware and software manufacturers (and the government, for that matter) don't count unless customers want the technology. Just because the industry and the press think something is a good idea doesn't mean customers will buy it. Remember the hype that accompanied handwriting recognition?

We in the press certainly can't predict all the specifics. That's one of the reasons why, when we sit down each year to create our idealized "Perfect PC" (page 100), we also survey our readers to find out how well the manufacturers are doing. See our stories on PC and notebook service and reliability (page 181) and software support and satisfaction (page 199).

Our responsibility is not only to choose products. As citizens, we have an additional responsibility to understand both the technology and its potential. The decisions we make in the next few years regarding the use, or misuse, of computer technology will shape the world of the next century.

The answer, therefore, is simple: Those of us who buy and use computer technology will determine its future path.

A stylized, handwritten signature of Michael J. Miller in black ink.

MICHAEL J. MILLER

SOME PEOPLE
WAIT FOR
OPPORTUNITY
TO KNOCK.

NOW YOU
CAN CLICK ON IT.

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SPECIAL ISSUE

How to Choose the Perfect PC

BY MICHAEL J. MILLER It's tougher than ever to choose just the right system for your needs, right? So many ads, so much hype, so many details!

That's why we spend each year testing and reviewing the hundreds of new systems that debut. And once a year we distill the findings of the past year's roundups to give you some basic guidance on choosing the perfect PC. Here, then, is our vision of various perfect desktop and portable PCs, as well as perfect network connections and devices. We also take a close-up of some critical components to help you understand your choice even better.....100

SPECIAL PULLOUT SECTION

1997 Buyers' Guide

Use this handy contact list and worksheet as you shop for your next great purchase of a desktop or notebook PC. We include 800 numbers, Web sites, and summaries of support and service policies, along with recommended specs on different systems, plus several worksheet areas just for you.....109



WWW.PCMAG.COM

More on the Perfect PC

How much does your perfect PC cost? Our interactive "perfect PC" price-quote system will e-mail your specs to any of several PC vendors that are waiting to deliver price quotes. Also on the Web: Interactive tours of our perfect PC configurations and an expanded version of PC Magazine's list of 100 most influential companies.

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Online Extra!
Price Your PC at
www.pcmag.com

READERS RATE DESKTOPS AND NOTEBOOKS

Service & Reliability



BY MARY E. BEHR AND GORDON K. PLUTSKY

Product reliability and customer service can still give one PC vendor a conspicuous edge over another. See how your fellow *PC Magazine* readers rated desktop and portable PC vendors on reliability, repair handling, and technical support in our annual survey181

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READERS RATE SOFTWARE

Support & Satisfaction



BY JOHN MORRIS

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THE MOST INFLUENTIAL COMPANIES

The PC Magazine 100



BY JAKE KIRCHNER

Which companies will steer the industry over the coming year? *PC Magazine's* editorial and Labs staff debated the question over two months and arrived at this list. Many are the usual suspects, but you'll find a few surprises here as well213

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Upgrade to OmniPage Pro and get the recognition you deserve.

OmniPage Limited Edition or **OmniPage Lite** is the OCR that came with your scanner. They give you basic OCR.

How to Improve Your OCR Accuracy

Caere Corporation (NASDAQ: CAER) recently announced an upgrade program that makes the OmniPage Pro optical character recognition (OCR) engine software available for an estimated street price of only \$129. This upgrade is available for users of any of the following Caere OCR products (including those bundled with flatbed and edge-feed scanners) that can upgrade to the full version of OmniPage Pro at a \$30 mail-in rebate.

OmniPage Pro has a separate upgrade package available through the Computer City, Egghead, and Best Buy Stores. Since the vast majority of Caere OCR users are eligible to upgrade to the new OmniPage Pro, the large number of scanner manufacturers that bundle Caere OCR software with their scanners are eligible for the upgrade.

The upgrade program includes OmniPage Pro 6.0 (Windows 3.1 and 7.0/Windows 95), which offers all the capabilities of the bundled software for extended functionality. Most notable among them are further "tuning" and preprocessing of scanned images, verification of the Page technology for the retention of the original page formatting, and OCR training and deferred processing capabilities.

The Changing OCR Market: In the not so distant past, OCR required expensive and OCR software that was often difficult to use and provided little or no support. These issues were frustrating and limited the use of OCR to high-volume vertical markets. The use of desktop OCR was limited to the

"Today several trends are contributing to the widespread use of OCR users faced," said Chad Kinzelberg, Caere's vice president of product development. "The program is another major factor that will promote the use of OCR. The program is another major factor that will promote the use of OCR. The program is another major factor that will promote the use of OCR."

Analysis following the OCR market agree that OCR use is on the rise and have identified trends promoting its

Higher Customer Awareness: An increased number of computer users are becoming more aware of the time and money saving benefits it provides.

Higher Scanner Penetration: Scanners prices have dropped drastically, making many flatbed gray-scale scanners available for under \$500. Also, the use of the small-footprint sheet-fed scanners and multifunction

Increased OCR Accuracy: OCR developers have developed high accuracy OCR technology for increased output. The greatest improvement has been made on degraded and hard to read documents.

Improve Your OCR and Save Big \$\$\$

Higher Scanner Penetration:

No scanner prices have dropped so dramatically in the last few years with many flatbed and gray-scale scanners available for under \$500. Also, the use of the small-footprint sheet-fed scanners and multifunction devices have entered the market.



Four color scanners entering the market have helped push OCR use to a new level.

Increased OCR Accuracy:

OCR developers have developed high accuracy OCR technology for increased output. The greatest improvement has been made on degraded and hard to read documents.

Pricing and Availability

OmniPage Pro 7.0 (Windows and Mac) and WordScan Plus 4.0 (Windows) upgrade packages are immediately available at major resellers for an estimated street price of \$129.

The Company:

Caere Corporation, with U.S. headquarters in Los Gatos, Calif. and European headquarters, Caere GmbH, in Munich, Germany, is a leader in OCR technology and desktop document management products. Caere has recently expanded its product line of OCR

OmniPage Pro gives you almost twice the OCR accuracy with the same ease-of-use as **OmniPage Limited Edition**.

OmniPage Pro keeps text in its original format and layout, including graphics.

OmniPage Pro even outputs to HTML.

continued on next page

OmniPage Limited Edition

OmniPage Pro

Upgrade now to faster, more accurate OCR.

Sure, the OmniPage Limited Edition OCR that came with your scanner is good. In fact, that's why scanner makers like HP, Microtek and Agfa chose it above all others.

But if you want greater accuracy, full-throttle speed and a ton of new time-saving features, then it's time you moved up to OmniPage Pro.

OmniPage Pro employs a new, more powerful OCR engine to recognize poor copies and degraded faxes. It integrates seamlessly with your favorite applica-

tions like Word, WordPerfect and more. It even guides you through the OCR process using its AutoOCR Toolbar. All with the simple push of a button.

What's more, you get the advantages of the world's most popular OCR software without learning an entirely new program. So make sure you're getting all the OCR power and accuracy you deserve. Visit a local computer retailer today to get your \$30 mail-in rebate coupon.



Now Just \$99

Key Feature Comparison	OmniPage Pro	OmniPage Limited Edition
Caere's fastest and most accurate OCR engine	✓	
AutoOCR Toolbar™ for easy, one-button OCR processing	✓	
OCR Wizard to guide you through the process	✓	
Integrates with most image editors like Photoshop	✓	
OCR from within your favorite applications	✓	✓
Retains original layout	✓	

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extension 10

Available for Windows 95, Windows 3.1 and Windows NT.

www.caere.com



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Pipeline

16-GHz Supercomputing

The U.S. Department of Defense has handed Rensselaer Polytechnic Institute professor of electrical, computer, and systems engineering John F. McDonald a \$1 million grant to build a 16-GHz supercomputer that will be 1,000 times faster than Intel's fastest screamer.

The DoD wants McDonald to build a "PetaOps" supercomputer (1,000 trillion operations per second), which would dwarf any existing computer's performance. The prospect makes IBM's vaunted chess champ Big Blue look like a weakling.

McDonald's basic design calls for an 8-way super-scalar architecture with a 16-GHz clock that could reach 128 billion operations per second. By lashing eight of these designs together, he expects to approach the speed of the DARPA-specified machine. Such a plan calls for radical approaches to cooling the computer.

McDonald based his design on heterojunction bipolar transistors (HBTs), which are related to homojunction bipolar transistors, on which mainframe computers were once built. The computer industry has abandoned

this technology in favor of CMOS (complementary metal-oxide semiconductor) transistors, but McDonald claims that as transistors shrink to sub-micron sizes, HBTs will be back in vogue, ushering in the fastest



computing speeds ever.

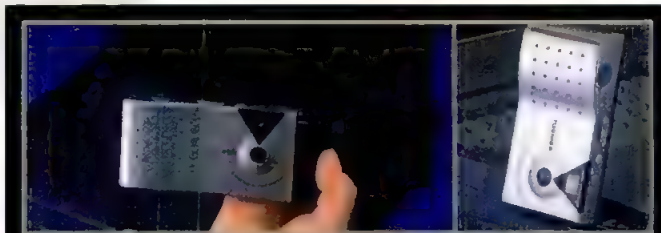
Intel's supercomputer, meanwhile, networks 10,000 Pentium Pro systems into a parallel computer. It is already used for large-scale simulations showing, for instance, the impact a nuclear explosion or a large meteorite would have on Earth. Professor McDonald's 16-GHz supercomputer could help unravel the human genome and improve the accuracy of weather predictions.

Online: Price the Perfect PC

www.pcmag.com

In this issue, we outline several enticing Perfect PC configurations, but how much is that machine of your dreams going to cost? Join us online, where we've created an interactive Perfect PC price quote system. Just pick the components you want and instantly e-mail your specs to any of several PC vendors, who are waiting to receive your price request. Soon you'll receive an e-mail with a current price quote. It's a great way to comparison-shop for the system that may see you through to the end of the century.

ALSO ON THE WEB: Check out the interactive tours of our Perfect PC diagrams and an expanded list of *PC Magazine's* "100 Most Influential Companies."

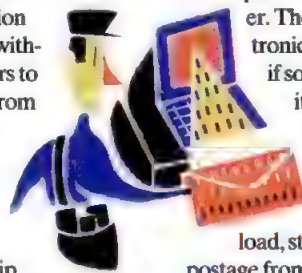


Peripheral Vision Toshiba's newest digital camera, the PDR-2, is a true PC peripheral that slips into a notebook's PC Card slot to download up to 48 images. The \$499 camera ships this month.

PC Postage

The U.S. Post Office is considering several proposals for PC-based postage. Born as a result of meter fraud, electronic postage could enable the estimated 10 million small businesses without postage meters to produce stamps from their PCs.

Neopost's PC-Stamp uses a modem-size box containing an encryption chip, which attaches to a PC. With a digital scale connected to the system, the PC can calculate postage and produce a bar code, or "indicia," that's printed on the envelope. Instead of shlepping the postage meter to the post office to get it reset, or resetting it remotely, you can get



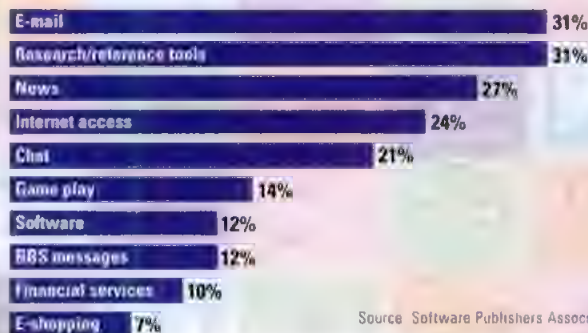
it refilled through your modem.

Meanwhile, start-up E-Stamp Corp. has developed the Internet Post Office, which downloads postage to a 2-inch-square adapter connected between the parallel port and the printer. The encrypted "electronic vault" self-destructs if someone tampers with it. The company's first product, E-Stamp SoHo, will let small businesses securely purchase, download, store, and print postage from their PCs.

The U.S. Post Office is being extremely cautious, says Neopost president Neil Mahlstedt. Initially, the services will be available only to businesses in Washington, D.C., and San Francisco. The PC postage meters should be available early next year.

Online Services: Top Ten Activities

Thirty-eight percent of homes in the U.S. have PCs, according to a recent survey by the Software Publishers Association. Half of these households use online services. Here are the most popular activities.



Source: Software Publishers Association

Pipeline

Ready, Set, Immerse

Software developer Interactive Pictures is spreading the word about its "immersive" photographic technique, called IPIX, which lets travel agencies, real estate firms, car manufacturers, and sports venues create

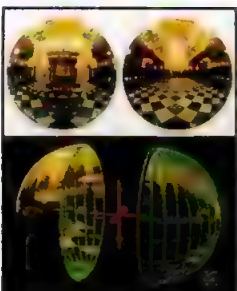
a digital camera with a fish-eye (180-degree) lens, you snap a shot, turn the camera around, and snap another shot. The images are circular and distorted, problems that "dewarping" software



remote walk-throughs for as little as \$50 a shot.

For the past ten years, engineers have been perfecting IPIX technology—an outgrowth of research at Oak Ridge National Laboratory in Tennessee—into telero-botic techniques for remotely handling radioactive material, defusing bombs, and flying unmanned helicopters inside enemy territory.

Interactive Pictures (www.ipix.com) has adapted the technology to more inviting applications. The idea sounds simple enough. Using



messages out of the picture.

The software then joins the front and back views to look like one photo, through which you can pan at any angle. With a browser plug-in, you can view it on the Web.

It may not be long before everyone can have a great seat at the ballpark, a rear-view mirror without the blind spot, or a window seat on the airplane. Interactive Pictures is now working with an airline that plans to mount cameras on the bellies of its jets and with a car maker that wants the "rear-view mirror of the 21st century."

An End to URLs

Let's face it: URLs can be really annoying, and the longer they are, the less likely you are to remember them or type them in. Bookmarks help, but only after you find a site for the first time. Wouldn't it be great if you could find John Doe's resume or Intel's annual report at addresses like "John Doe's Resume" or "Intel Annual Report"?

Arlington, Virginia-based Network (www.network.com) has developed a system to make such addresses possible. Anyone can go to its Web site and register a "personal network" for a fee of \$1 per month. Companies and organizations pay \$5 monthly. Any holder of a network can

edit its pointer easily at any time.

A Web surfer who downloads the free 150K Network agent simply goes to the browser's address line and types in the network. Type "tonight show," for instance, and you'll go straight to www.nbc.comtonight-show/index.html, drilling deep into the NBC site. Network has already set up 30,000 networks (including "PC Mag").

The company will warn individuals who attempt to snap up lots of trademarked networks (such as "Compaq," "IBM," or "McDonalds") that it can take a network away if the trademark's holder requests the word. That way, there will be no black market in networks, as there is in domain names.

Microsoft's Proving Ground

To prove that Windows NT can handle the most demanding database applications on Earth, Microsoft is working with the U.S. Geological Survey and the Russian space agency on the Terra Server. Located at Microsoft headquarters in Redmond, Washington, the terabyte-size, 140 million-record database—running on a Windows NT server, naturally—serves up satellite images of Earth over the Web. "This represents the kind of terabyte database we're going to see," says the demo project's architect, Jim Gray. It uses the upcoming version of Microsoft SQL Server, code-named Sphinx.

Just how big is a terabyte of data? Equal to 1,000 gigabytes, it's pretty darned big. All the HTML pages on the Web don't make up a terabyte, all transactions ever made in the New York Stock Exchange amount to half a terabyte, and the Human Genome Project is around 3 gigabytes.



WINDOWS NT AT WORK: Microsoft and Tandem have built a 64-chip, 2TB, 30 billion-record database.

Ink Spots on Display

Engineers from the Canon Research Center in Kanagawa, Japan, created a sensation at the recent Society for Information

trons are emitted from a thin film of palladium oxide (PdO) placed over pairs of electrodes. A Canon BubbleJet BJ-10 print head sprays PdO dots in precise locations on the screen. SED could prove a low-cost way to produce large flat panels.

Meanwhile, manufacturers continue to improve cathode-ray tubes. Sony's Trinitron (left) has a flat screen instead of being curved in one plane (the usual design). It has a 16:9 aspect ratio for HDTV and a wide-angle deflection yoke that minimizes the tube depth.

Nineteen-inch tubes are also generating interest, as a step between 17- and 21-inch monitors. By making the screen flatter, Hitachi has built a 19-inch tube that has a larger viewable area.



LONG LIVE CRTS: Sony's new Trinitron is sized for HDTV.

Display symposium in Boston, where they showed a flat panel that uses ink jet technology in the fabrication process. In the Surface-Conduction Emitter Display (SED) technique, elec-

Top-Selling Retail CD-ROMs

- 1 **Microsoft Windows 95 Upgrade** Microsoft
- 2 **Diablo** Blizzard
- 3 **PrintMaster Gold Deluxe Publisher Suite** Mindscape
- 4 **Myst** Broderbund
- 5 **Command & Conquer Red Alert** Virgin
- 6 **First Aid Deluxe** CyberMedia
- 7 **X-Wing vs. Tie Fighter** LucasArts
- 8 **Quicken Deluxe** Intuit
- 9 **Command & Conquer Counterstrike** Virgin
- 10 **Viruscan** McAfee

Source: PC Data. Data for April.

THIS ISSUE'S CONTRIBUTORS: Carol Levin, Alfred Poor, Sebastian Rupley, and Don Willmott.

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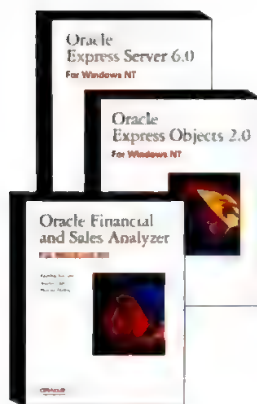
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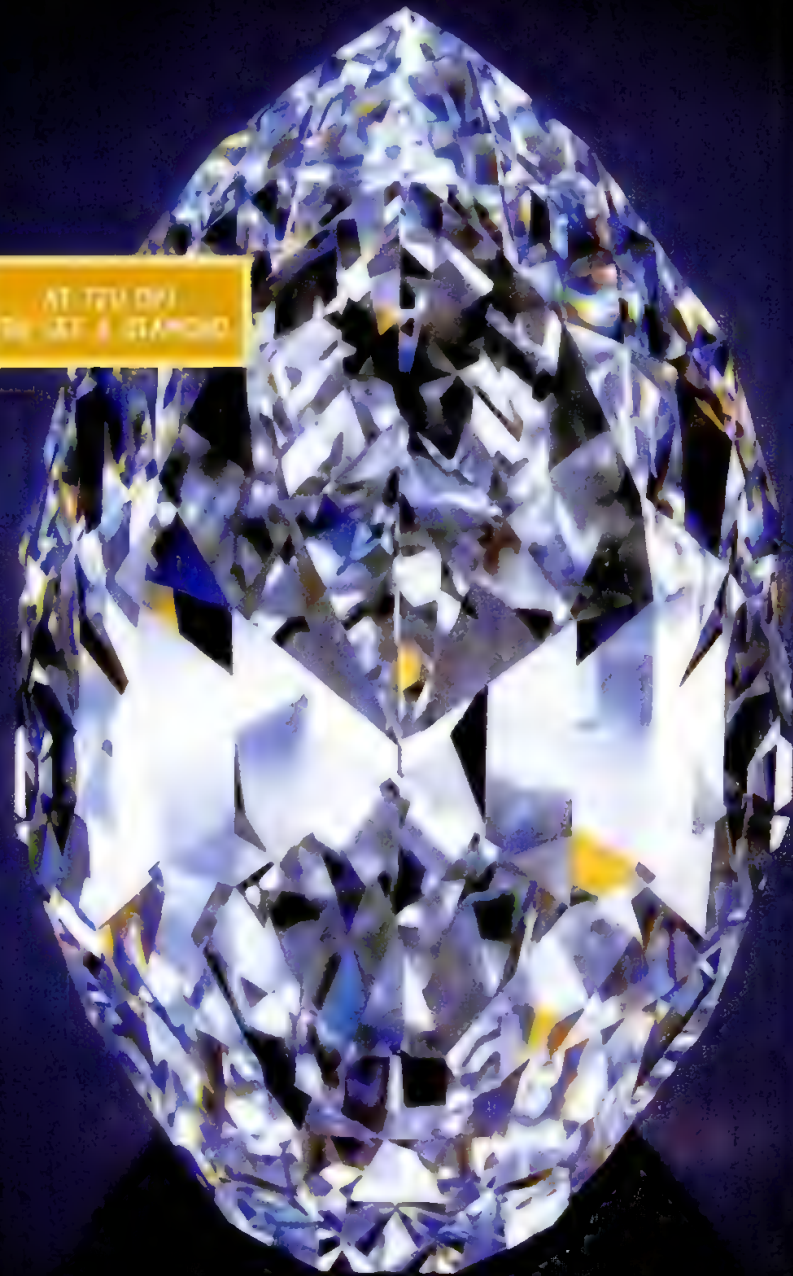
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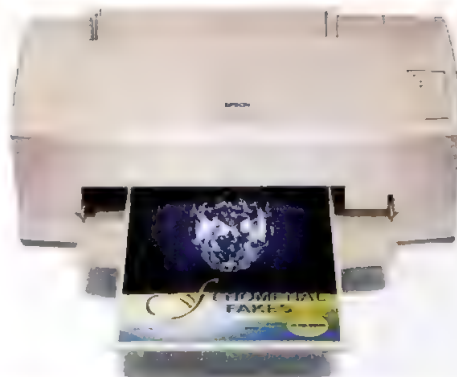
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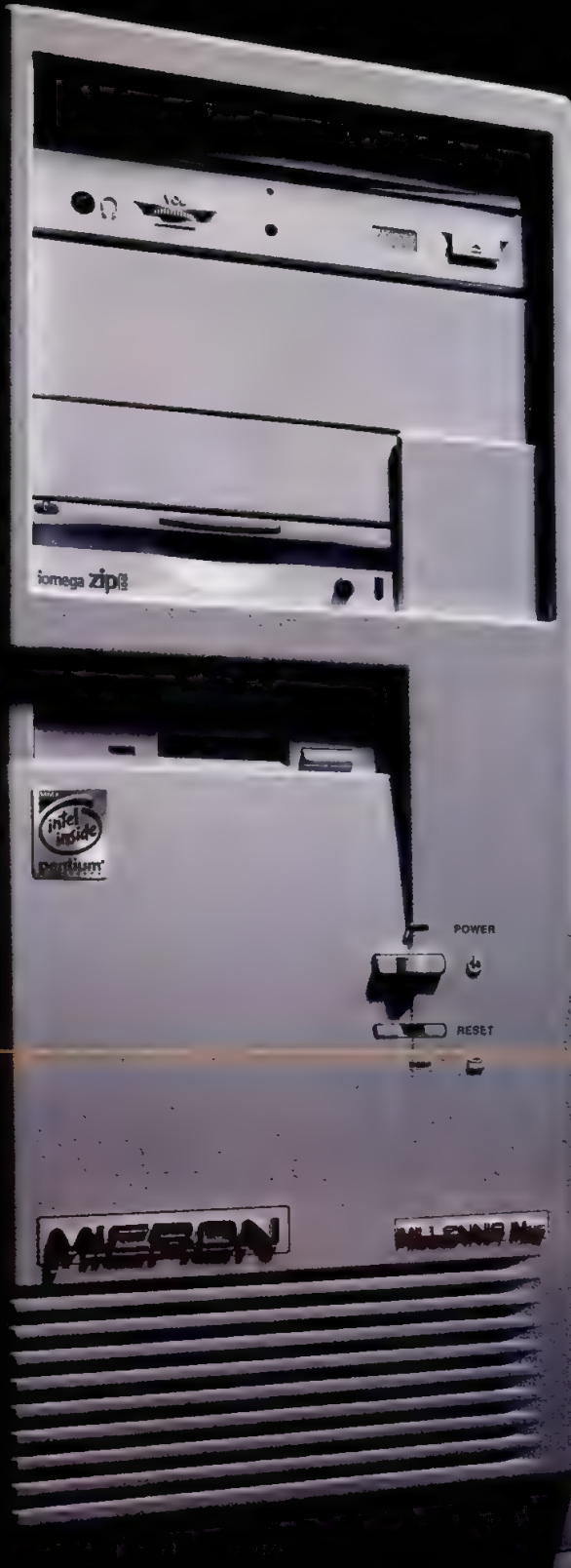
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Letters

SHOW US THE GOOD INTERNET

I agree whole-heartedly with Bill Machrone's column "Digital Scapegoat" in the April 22, 1997, issue. It's about time that some television media outlets started reporting on the good points of the Internet, such as Project Gutenberg or NASA's Web site.

MIKE MENZEL
Calgary, Canada

My compliments to Machrone and his tantrum over TV newscasting of Internet scare stories. I'm sure his theories on why broadcasters continue to do this are accurate, but it's important to remember that TV news reporters think intuitively. They see every telephone as a potential access point to the Internet. Compare the number of telephones with the number of adult bookstores in your town and you begin to understand how they think.

TOM WOODWORTH
via the Internet

Everybody's heard of the Internet, but relatively few people have enough experience with it to be blasé about it. Online activity is still a novelty for most people. These days, news has to be novel to be worthy of air time, and an Internet reference spices up stories that would be prosaic and familiar without it.

BRIAN B. MULHOLLAND
via the Internet

I share Machrone's frustration at TV's dark depiction of the Internet. Many TV-reliant parents are afraid to let their kids have Internet access. Maybe someone should tell them that their kids can also use the Internet to learn more about the universe, see some of the world's greatest art, and even browse the complete works of William Shakespeare.

RANDELL GRENIER
Waltham, Massachusetts

To suggest that CNN and other stations broadcast bad news about the Internet in order to generate interest is ludicrous. In every report Machrone mentions, the Internet had a definite relevance.

FLETCHER BUMPUS
via the Internet

PALLETABLE

Your article on illustration packages in the April 22, 1997, issue ("The PC Palette: Illustration") was very interesting. I currently use two of the packages reviewed—Micrografx Designer and Macromedia's FreeHand—and find them both very useful, with Designer being my choice for cross-platform compatibility with the Macintosh-based print shops in the area.



*"I share Machrone's
frustration at TV's dark
depiction of the Internet."*

I've produced illustrations for publishing on the PC for several years and must agree with your results. While CorelDraw was easy to use and powerful, there were color inconsistencies between the screen and printed output. Adobe Illustrator 4.0 was behind in features. Then someone suggested a competitive upgrade of Macromedia's FreeHand 7, an interesting idea for several reasons: I'd get the latest upgrade; FreeHand is Illustrator's main competition; and I had heard that FreeHand handles Illustrator files more easily than Illustrator does. I'm now happily getting my work done in FreeHand.

BARTON STABLER
Westfield, New Jersey

Adobe PageMaker is considered throughout my company's art department as an application to be avoided at all costs. How could you rate this product a best buy ("The PC Palette: Desktop Publishing," April 22, 1997)? Copy-and-paste operations alter the leading, kerning, and line breaks of just about every text block you try them on. Printing is a nightmare of PostScript errors, font substitutions, and low-resolution images. Adobe's technical support is absolutely no help, blaming just about everything else besides their application.

BRIAN A. PYLANT
via the Internet

In your review of desktop publishers, you did not mention an important but so far totally overlooked feature of HTML generation from within programs. I discovered this the hard way,

of a few months to put up on my Web server to get comments from people. I soon realized that Publisher 97 does not generate JPEGs, for my beautiful scanned photos came out as ugly 256-color GIFs. The ability to save your pictures in JPEG format is vitally important for any HTML publishing tool today.

SCOTT McMAHAN
Asheville, North Carolina

IMPLICATIONS

I was frustrated by the tone set by the First Looks review of the Compaq Presario 2100 ("The \$1,000 PC—Sort Of," April 22, 1997). This review boils down to two basic observations: that the computer is priced below \$1,000 without a monitor and that its performance is subpar. That the average used for comparison is calculated in a roundup of 200-MHz Pentium-based computers is not highlighted or justified. The implication for a computer novice is that other sub-\$1,000 133-MHz computers do exist and offer the performance of 200-MHz machines. This does a disservice to the reader. The implication for non-novices is that the comparison is groundless, since no information is given in regard to performance within its class.

MARK LOBODZINSKI
Dallas, Texas

WORKSTATIONS AND DESKTOPS

In your recent comparison of graphical workstations ("Workstation Wars," April 22, 1997) you complained about the software installation nightmares associated with the article. I find this comment unfair. Seemingly, PC Magazine's technical crew is well versed in the Windows platform but has little prior experience with Unix boxes. Given a high level of expertise with one platform and none with the other, it should come as no surprise that installation of software on a Unix box brought more headaches than your technicians are used to. Unix boxes aren't any more difficult to install software on than Windows-based machines; they are simply quite different, and the same rules and tricks do not apply.

CRAIG STARK
via the Internet

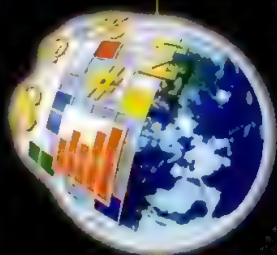
We've now run four workstation stories since 1991, and Unix seems as complex now as it did in the mid-eighties despite the more aesthetically pleasing and user-friendly front ends. We found ourselves going to the shell too often, but then again, Windows NT and Windows 95 can be problematic when you have to dig into driver and hardware compatibility problems or the Registry. We quickly got over the arcane

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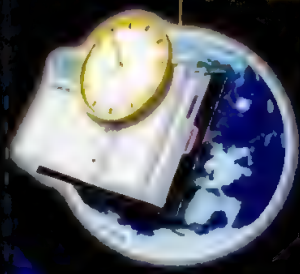
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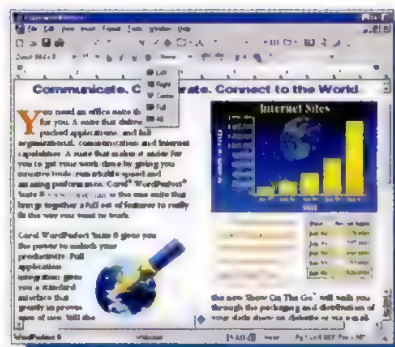
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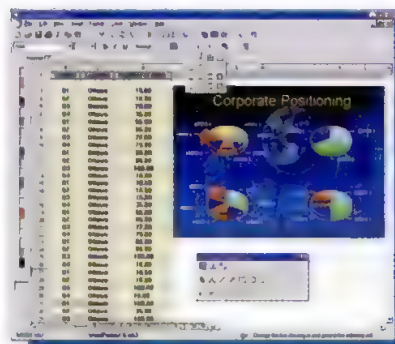
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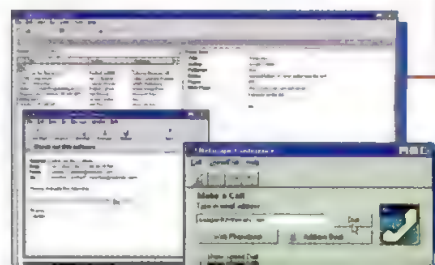
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Letters

Your article on graphical workstations was both interesting and informative. But it failed to clarify the differences between a workstation, like the HP Vectra XW, and a high-end desktop computer, like the Micron Millennia Pro2, which has many of the same features—including dual Pentium Pro processors—but costs half as much. For those of us who are planning to purchase a more powerful computer, it would help to have some comparative data for a representative single- or dual-processor Pentium Pro computer.

BEN MASSELL
via the Internet

VALUE VS. COST

I read with interest Michael J. Miller's comments regarding total *value* of ownership ("Total Value of Ownership," April 22, 1997), as opposed to total *cost* of ownership (TCO). As a career IS Manager, I constantly have to defend the cost of a computer, and the TCO is the point that most nontechnical management people bring up. It's important, certainly, to analyze the cost of ownership. However, such evaluations are extremely subjective, and there are many other aspects to the value of a PC beyond the actual cost. Realistically, it's the nature of the PC to be replaced every three years by a newer, more capable model. It is also the nature of the industry to stick with the \$2,500 price point. Our very nature makes us want to hold on to PCs far beyond their expected life span. I never feel I'm wasting money when I replace my home PC every two or three years, simply because I get a great deal of use out of the unit. It's up to each of us to get the most

CORRECTIONS AND AMPLIFICATIONS

In the First Looks article "Service for Two" (May 27, 1997), we stated that the Dell PowerEdge 4100 has an Intel motherboard when in fact it has a Dell motherboard. We also stated that ALR's Revolution MP Pro has an AMI motherboard when it's actually an ALR board.

In reference to our May 6, 1997, Trends/Peripherals story on high-speed CD-ROM drives, the correct model numbers for the new LG Electronics 16X drives are CRD-8161B and CRD-8160B.

In our May 6, 1997, feature story "Top 100 Hardware Accessories," details and contact information for the Tumi computer briefcases ("Gadgets to Go") were incorrect. The correct name of the line is Tumi SafeCase, and the bag pictured is the SafeCase Deluxe Computer Brief (\$335 list). Tumi can be reached at 800-322-8864.

In the April 22, 1997, issue, the features table "Desktop Publishing Software" (page 155) incorrectly listed Adobe FrameMaker 5 as not handling cross-references; the review correctly stated that it does.

In the April 8, 1997, issue, the review of Quick View Plus 4.0 ("File-View Utilities," page 162) incorrectly stated that the program supports the AutoCAD file format (.DWG files). It does not, although it does support .DXF (Drawing Interchange File), which is not automatically generated by AutoCAD.

value out of a particular PC while it is still useful. Maybe then we wouldn't feel so ripped off when it inevitably needs to be replaced.

JOSEPH HARDEGREE
via the Internet

NO WIRELESS PROFIT FOR LAMARR

I'd like to point out two interesting facts to Jim Seymour regarding his mention of Hedy Lamarr and her frequency-hopping patent ("Go Wireless Today, Not Someday...," April 22, 1997). First, the term of a patent is 17 years. In this case, the term of the patent expired in the early 1960s, long before she could have benefited financially from the recent use of the technology. Second, she did not retain the rights to the patent, and in fact she and coinventor George Antheil donated them to the U.S. government. I can understand not knowing the assignment of the patent, but to me Seymour is primarily a technologist, and he should have known better or at least consulted someone who did. The implication that Hedy Lamarr's relatives are sitting home getting rich is a gross misstatement of the facts.

STEVEN NICHOLS
via the Internet

PAY-PER-PLAY NOT ENGAGING

Engage Games Online president Jeff Leibowitz, who said, "The subscription model simply does not work for games" ("Pay-per-Play Web Games," Trends, April 22, 1997), subsequently champions hourly charges of \$1.95 to \$2.50 as opposed to subscription fees for the use of Engage's online games. Hourly charges have driven gamers away from online services; such charges have no place in today's market. Gamers like me play online more than 15 hours a week, and our pockets are just not that deep. Mpath Interactive has instituted a subscription fee of \$29 per year for its

premium service, while TEN has attracted thousands of patrons and charges subscribers \$30 per month. Both services seem to be doing quite well despite Mr. Leibowitz's hypothesis.

BRETT OETTING
via the Internet

I'm an avid Internet gamer, typically playing from 6 to 12 hours per week. Honestly, I'm amazed that the pay-per-play model has survived in any form. I will never spend a cent playing online games. After I drop \$50 to \$70 buying a game, there's no way I'm going to pay to play it. I'm far more likely to play a game like Quake—where you type in the IP address of the server and away you go—than to go through the hassle of using a service to play games. I would also be far more likely to purchase a multiplayer game if it has the Internet support Quake has, and I don't believe I'm alone.

DAVID KUHN
via the Internet

LOST IN THE STATE OF THE ART

I read with interest Bill Howard's column "Taking Multimedia with You" (April 22, 1997). I am a frequent speaker who likes to use visuals; most of my speeches, however, are uncompensated. There is a vast difference between showing transparencies on the overhead projector and on the state-of-the-art panels and projectors Howard discussed. He also mentioned that "by midyear we'll begin seeing true 1,024-by-768 devices." For the poor lecturer who does not need state-of-the-art equipment, what happens to the less than state-of-the-art panels and projectors? Unlike other computer equipment, these items just do not seem to be available anywhere.

WILLIAM BOKLUND
via the Internet

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Trends

The Internet on Wheels

Cars talk, navigate themselves, and surf the Web.

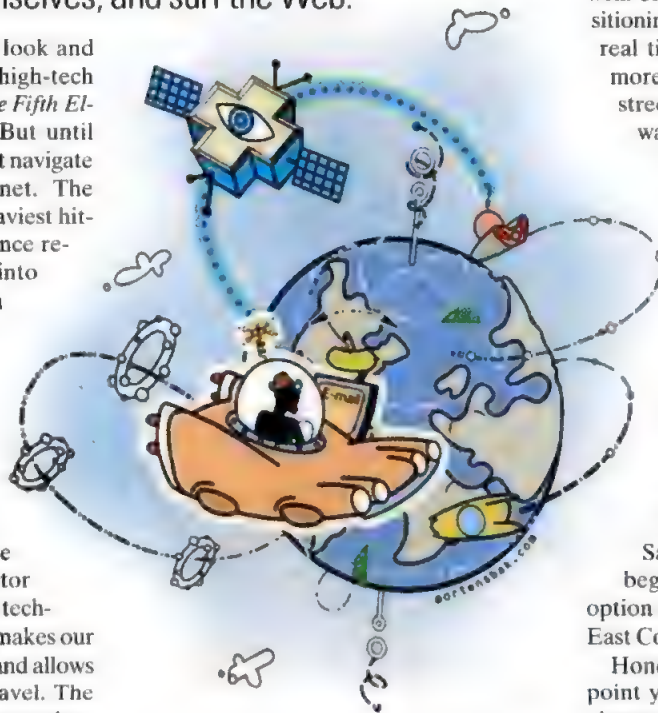
Cars of the 23rd century may look and act a lot like Bruce Willis's high-tech airborne taxi in the movie *The Fifth Element*, rocket boosters and all. But until then, you can expect more cars that navigate themselves and surf the Internet. The computer and auto industries' heaviest hitters are integrating technology once reserved for the office and home into our favorite home away from home: our cars.

Integration of a Pentium chip for on-board Internet access may be the next step in the evolution of the smart car. Intel recently unveiled a strategy called Connected Car-PC, which seeks to bring computer functionality to the car. Says Dr. Ron J. Smith, vice president of Intel's Semiconductor Products Group, "This is the same technology that entertains us at home, makes our business competitive at the office, and allows us to stay connected while we travel. The automobile is the next logical venue to adopt this technology."

Intel envisions a future in which your car will be able to surf the Internet, download documents, send and receive e-mail and faxes, conduct stock transactions, and access weather reports. There will also be applications for kids cooped up in the back seat, including DVD technology for multimedia games, educational software, and movies. The key ingredients, says Intel, are a voice recognition system and a simple graphical user interface.

Recently Daimler-Benz, which makes Mercedes cars, demonstrated a concept car dubbed The Internet Multimedia on Wheels, which functions as a node on the Internet, complete with its own IP address. Through a wireless communication sys-

MOUSE DRIVER? Stay connected with a souped-up car from Acura, BMW, or Mercedes.



tem, it allows the car's occupants to access any Internet server.

What's the point of all this? Someday you'll be able to access Internet-based roadside services that will diagnose car problems remotely, as well as push technologies that will send you news headlines and weather reports while you're on the go. By means of



wireless keyboards and displays in the backs of the front seats, passengers will be able to play games on the Internet and access other information applications.

Car drivers will have access to services through voice commands.

Daimler-Benz's concept car features a Global Positioning Satellite (GPS) system as well. Car manufacturers are using Global Positioning Satellite to provide information in real time so that drivers can get around more efficiently, bypassing congested streets and navigating perplexing highways and back roads.

BMW and Honda (through its Acura division) are also outfitting several models with GPS systems. Japanese consumers have taken to the technology, buying souped-up Acuras in droves, according to company representative Mike Spenser. He attributes these sales to Japan's higher level of comfort with high-tech gadgets. "It's virtually impossible to sell a new car there now without a navigation system," he says. Sales of Acuras with the Acura Satellite-Linked Navigation System began in the U.S. last May; the \$2,000 option is available in California and on the East Coast.

Honda employs a GPS receiver to pinpoint your location to within 100 meters, electronic sensors that detect when your vehicle turns and how fast you're traveling, and mapping software that's loaded on a hard disk in the trunk. All you have to do is enter your destination—by address, intersection, or name (including the names of banks, airports, hotels, restaurants, and shopping centers)—and the touch-screen LCD on the dashboard will display your location and provide you with step-by-step, voice-guided directions.

SAFETY FIRST

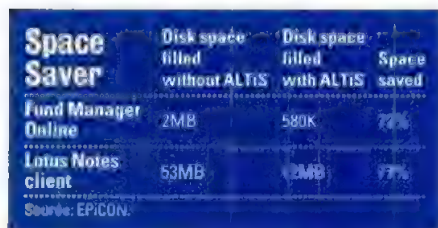
Recognizing that much of this technology could be distracting to drivers, the industry is focusing on hands-free interaction with these systems. Intel, for example, foresees a day in which data downloaded from the Internet will be converted to voice. And for safety reasons, BMW recommends entering your destination only when the car is stopped. This will be good advice until cars can drive themselves.

And for that matter, don't expect to see any Internet applications in your sedan anytime soon. Production cars are about ten years away.—Angela Hickman

The Fit Client

Just-in-time Windows apps.

A new class of application-delivery systems is bridging the chasm between traditional programs, or *fat clients*, and Internet-based software, or *thin clients*. Fat clients are difficult to manage and transport over networks; thin clients, such as Web browsers, are lightweight but don't provide rich or sophisticated user environments. The new systems combine the best of both worlds



ECONOMY DOWNLOAD: ALTiS efficiently delivers apps over the Web.

to deliver "fit clients": They store application files centrally on a server, then send the appropriate executables and other files to a local cache when a client needs them.

Marimba was the first vendor in this category, offering Castanet, a system for distributing Java applications efficiently. Now EPiCON thinks it has found its own happy medium in a system for distributing Windows applications. This fall, EPiCON plans to launch an application-delivery product called ALTiS, which is conceptually similar to Castanet in offering central application management. One of the biggest costs in maintaining network applications lies in installing and upgrading user software on every computer. With these new products, administrators can update an application in a single location, and the systems' client software updates the program when the users access it.

There are two important distinctions between ALTiS and Castanet. First, ALTiS sends users only the parts of the application that they need immediately, while Castanet sends the entire application. And second, ALTiS distributes Windows apps, whereas Castanet currently supports only Java programs. With ALTiS, companies will be able to use an existing Windows application without rewriting it in Java or porting to an HTML-based system.

EPiCON touts ALTiS's componentized application delivery as "what you need is what you get." ALTiS downloads data for an application's features only when you access them—a method that echoes the thin-client proponents' claim that 80 percent of users access only 20 percent of an application's features.—Todd Spangler



Pentium II Tests Revisited

IN OUR JUNE 10, 1997, STORY TITLED "Pentium: Part II," we tested the first 15 Pentium II systems released to market, and we compared them with Pentium Pro, standard Pentium (of both MMX and classic varieties), and AMD K6-based units. Unfortunately, after some feedback, we've recognized that we could have explained certain tests more clearly.

We reported that the K6 outperformed the Pentium II on certain tests, results that we later attributed not to the chip but to faster hard-disk access.

We ran 17 separate benchmark tests under Microsoft Windows NT 4.0 on all systems, and 9 different tests under Windows 95 on a select subset of systems. Benchmark tests included our High-End, Business Winstone, and WinBench suites, and specialized Photoshop tests. The Photoshop tests, run under both Windows 95 and Windows NT, specifically targeted MMX functionality under Windows NT.

The Windows NT configurations included 64MB of system memory, while the Windows 95 systems were configured with 32MB of system RAM (to mirror typical user configurations). The lower Windows 95 memory configuration severely affected our Photoshop results. In fact, a tremendous amount of disk swapping was observed on all tests (Gaussian Blur, Unsharpen Mask, and Facet filters), because we used a 15MB TIFF file as the source image. Although our Windows 95 results were still valid, we should have communicated the heavy influence of the disk subsystem. Under Windows NT, the Photoshop tests barely caused disk activity, because of the larger pool of memory.

We purposely selected the above-mentioned Photoshop filters because they use MMX instructions. The 64MB Windows NT configuration allowed comparison of MMX processing power on those

selected Photoshop tests among the various systems, but the disk activity squelched meaningful MMX processor comparisons under the 32MB Windows 95 configuration. CPUmark₃₂ and CPUmark₁₆ results were not affected by the memory differences, because of their smaller memory requirements, but all the Pentium II systems had better scores with Windows NT than with Windows 95 on our Business Winstone tests.



Our Win 95 results were valid but didn't reveal the influence of the disk subsystem.



In our comparison of K6 systems versus Pentium II systems running the Photoshop tests under Windows 95, we stated that the K6 ran "MMX software" more efficiently than the Pentium II, but in fact the MMX capabilities of the processors had little to do with those Photoshop results, as the disk subsystems were the major factor. In any event, the K6 and Pentium II systems (the 233-MHz AST Pentium II and the 233-MHz

Polywell K6) were basically tied on the Unsharpen Mask and Facet filter tests, and the AST outperformed the Polywell by about 18 percent on the Gaussian Blur test.

We found that the 233-MHz AMD K6 reference system using a 10,000-rpm Seagate Cheetah drive outperformed the entire field on the Photoshop tests under Windows 95, substantiating the disk subsystem effects. In subsequent testing, we fired up the 266-MHz Sys Technology Pentium 266 using the Cheetah drive and ran the same Photoshop tests under Windows 95. Lo and behold, the system's performance was similar to that of the AMD reference system on the Unsharpen Mask and Facet filter tests, and it was better by about 25 percent on the Gaussian Blur. Again, these tests were disk-bound.

We'll soon be conducting extensive tests across all the popular AMD, Cyrix, and Intel processors for an upcoming story focusing on the competing chip technologies.—Nick Stam

Pushing TV

Digital TV, video, and high-speed push technologies meet on the PC.

Spurred by the FCC's mandate that all TV stations offer digital programming by 2002, a new crop of TV- and PC-centric products and technology initiatives are taking shape. Television, operating systems, and more devices will see sweeping changes as digital video and PC technologies merge. Push content from the Internet, a hot topic in its infancy on the PC platform, is quickly becoming equally hot in the world of television broadcasting.

Several recent developments suggest that the convergence between PCs and TVs will rapidly accelerate. The first was Microsoft's new positioning of its Broadcast Architecture for Windows, a cable TV-like interface that lets you choose content on-screen from the Internet, local TV, cable TV, and other sources. Microsoft introduced the technology in June 1996 and says it will include the soft-

ware in the next versions of both Windows 95 (code-named Memphis) and Windows NT (version 5.0).

Microsoft has also announced a new specification for delivering data over the vertical blanking interval (VBI) of analog broadcast signals, which will enable the downloading of data at 56 Kbps to PCs with the necessary hardware. This push technology creates a one-way channel to the consumer, allowing TV producers to transmit program-specific, HTML-based Web data along with the analog signal.

In addition, WavePhore has demonstrated its WaveTop Home PC Broadcast Network, a high-speed push service that uses the VBI to broadcast customized content. Through an alliance with PBS, WavePhore claims, it will have access to over 99 percent of the U.S. population when

it's ready to go online this fall.

A much higher-speed push alternative is Direct Broadcast Satellite PC (DBS-PC), a service from DirecTV and Echostar, which is expected to go live later this year. Based on a satellite receiver card manufactured by Adaptec, DBS-PC runs at 30 Mbps, periodically downloading selected Web-based information to your hard disk.

Both Microsoft and Oracle have set their sights on PC/TV convergence. Microsoft recently purchased WebTV for \$425 million, a step that will enable it to offer low-cost TV sets with built-in Internet capabilities. And Oracle quickly answered the move by acquiring Netscape's affiliate Navio, which is aiming to bring Netscape browser technology to televisions and other consumer devices.—Jan Ozer



JAKE KIRCHNER

Selling PCs the IBM Way

The IBM Personal Computer Company, the industry's lumbering giant, has been on a bit of a tear. Lost until recently between the rolling thunder of industry juggernaut Compaq and the stupendous growth of direct-sales leader Dell, the IBM unit has wracked up 12 months of solid growth—the result of a hard-won turnaround in technology and marketing.

While Hewlett-Packard has stumbled in recent quarters, IBM ended this year's first quarter with impressive gains throughout the prior year, which helped it maintain its number two slot in corporate desktop and notebook sales.

Building on the continuing success of its ThinkPad portable PCs, IBM has streamlined its desktop line of products and timed their introduction to coincide more closely with the availability of the latest technologies. For instance, the company had two machines ready for introduction at the rollout of Intel's new Pentium II processor in May.

More important, at least in the estimation of IBM officials, is a new marketing strategy. While Compaq and HP scramble to find winning price and feature combinations to ward off Dell, Gateway, and the other hard chargers in the business, IBM has chosen a different path.

Recognizing that it was not successful competing solely on technology and price, the IBM PC Company decided it has to be "an IBM company rather than a PC company," according to Jim McGann, program director, Commercial Desktop Systems.

The new approach is reminiscent of the tried-and-true IBM mainframe sales method: Overcome the several hundred dollars price premium that each PC might carry by selling the customer's chief information officer or CEO on a total package of products (clients to



servers), support, maintenance, services, and financing. Much of the strategy is encapsulated in the company's recently announced SystemCare initiative, which emphasizes the "total benefit of ownership" rather than the more trendy "total cost of ownership."

"We realized our customers are not in business to save money but to make money," McGann said, explaining the company's decision to emphasize a total solution approach to corporate PC sales. It's a strategy that works well with large corporate customers looking to buy 10,000, 50,000, or even 100,000 PCs at a time. But the company recognizes that its new approach doesn't work as well with smaller corporate customers, whose PC purchases of mere hundreds at a time amount to millions of total systems every year. Unfortunately, the company doesn't have much of a strategy to attack this segment of the market, which Dell is gobbling up.

And IBM is far too cavalier about the technology challenges of this marketplace. Company officials will tell you that its customers take it for granted that IBM will always have the leading-edge technology. But that's a reputation that—outside of notebooks—has not been an IBM asset over the last few years. And technology leadership is extremely difficult to maintain in this business.

If nothing else, though, it does appear IBM has learned some hard lessons over the last few years. As Anne Gardner, general manager of Commercial Desktop Systems, said recently as she looked back on the past 12 months: "We're real bullish, but we know the competition is not standing still. The earth is going to shift underneath us every week."

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* Estimated street price. All performance tests conducted by Matrox Graphics Inc. on a Gateway 200 MHz MMX with 32 MB of RAM and 512K cache. Matrox Mystique 220 Business, Diamond Stealth 3D 2000GL, STB Nitro 3D, and ATI 3D Pro/Video + PC2TV were configured with maximum memory configurations using driver releases 3.41, 4.03.00.3105, 1.50K and 3.03 respectively. WinBench 97 business tests conducted at 1024 x 768 @16-bit at 75 Hz using small fonts under Windows 95. 3D WinBench 97 tests conducted at default resolution of 640x480 @16-bit at 75 Hz with DirectX™ 3a using small fonts under Windows 95. WinBench settings were dictated by Quality Suite responses for the respective products.

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Trends PCs

WORKSTATIONS

Up on Deck: The 300-MHz PC

Intel may have announced the 300-MHz Pentium II back in May along with the 233- and 266-MHz versions of the processor, but industry sources claimed at the time that fewer than 50 such workstation chips were available worldwide. Consequently, 300-MHz x86 processing isn't likely to reach the market before the end of July or August.

The first motherboard certified to run the 300-MHz Pentium II was the Tahoe 2 ATX, from Tyan Computer. Using a makeshift system built around this dual-processor board, PC Labs recently tested Intel's workstation processor and saw an almost linear improvement over the performance of the 266-MHz desktop model (discussed in "PC Labs Helps Build a 300-MHz Pentium II PC," June 24, 1997). The Tahoe 2 ATX is available in several 266-MHz Pentium II systems, including the Symetraz Workstation, from NeTPower ("Pentium: Part II," June 10, 1997), and the TD-255, from Intergraph Systems (800-692-8069, www.intergraph.com).

Intergraph, however, has since designed its own 300-MHz Pentium II motherboard. Naturally, the board's pair of SEC slots can also run slower Pentium II varieties, but its salient feature is support for Intel's \$1,981 300-MHz workstation chip. And like all of the current Pentium II boards, it uses Intel's 440FX chip set.

The first machine to use the board is the **Intergraph TD-425**, sure to be one of the first 300-MHz workstations to arrive on the market. Intergraph has not finalized the system's pricing yet but says that it will sell for "roughly \$2,500 more per processor" than a comparable 266-MHz



Pentium II machine (which costs approximately \$10,000). With a price tag that may reach \$15,000, the workstation is obviously meant for the upper echelons of the market.

The Adaptec UltraSCSI controller that's integrated onto the TD-425's motherboard connects to a 4GB Seagate Barracuda UltraSCSI hard disk. A variation of this 7,200-rpm drive is used in Compaq's Pentium II desktop, the Deskpro 6266/M4200/CDS ("Pentium: Part II"). The Intergraph workstation also features the company's G95 graphics card, which uses the Matrox Millennium chip set and 8MB of WRAM.

Using our standard benchmark-test software, we tested the TD-425 with a single 300-MHz Pentium II; a second processor improves performance only under rare multithreaded applications. Though the system's Business Winstone score was only 2 percent higher than that of the average 266-MHz machine in our recent Pentium II roundup, it outperformed the average 266-MHz machine under CPUmark and High-End Winstone by 4 percent and 6 percent respectively. It's 7,200-rpm hard

disk was average relative to the 266-MHz systems (many of which used 10,000-rpm disks), but graphics and CD-ROM scores were well above average.

Our makeshift Tyan machine was a slightly better performer but used a 10,000-rpm SCSI drive and probably the finest mainstream graphics board on the market, the Matrox Millennium II.

In the tested configuration, the TD-425's integrated Vibra 16 audio subsystem connects to a ConcertMaster Multimedia keyboard, which integrates its own SRS 3-D stereo speakers, a microphone, a subwoofer jack, and a headphone jack. The package price will also include a breathtaking 21-inch Digital Multiscan color display, two USB ports, and an integrated Intel 10/100-Mbps Ethernet controller.

Do not mistake the 300-MHz Pentium II for a desktop. As the TD-425 exhibits, the chip will be used only in extravagant workstations at least through the end of this year. The chip will be expensive—since current pricing pins it at \$1,981 for manufacturers—but it will also be fast.—Cade Metz

UPGRADES

Take Your PC Up a Notch

Intel's OverDrive isn't the only game in town when it comes to processor upgrades. Evergreen Technologies (888-607-7333, www.everttech.com) has introduced two end-user upgrade chips for low-end Pentium desktops, as well as a factory upgrade for x86 portables.

Using the **Evergreen PR166 Processor for Pentiums**, end users with 75-MHz or higher machines can quickly achieve up to 166 MHz and high-end Microsoft Windows 95 performance. Though the upgrade sells for only \$259 and lacks MMX Technology, Evergreen claims that it rivals the proficiency of Intel's \$499 MMX OverDrive processor. The PR166 is based on the Cyrix 6x86 chip—which is comparable to the classic Pentium—and has been available since mid-May.

Later this summer, Evergreen will ship its MMX upgrade: the **MxPro Processor for Pentiums**. Based on the AMD K6 chip, the MxPro can outfit any existing Pentium desktop with a 166-, 200-, or 233-MHz

clock speed and the multimedia enhancements of MMX Technology.

With prices starting at under \$500, this could be a key technology for Evergreen. Intel has not announced an OverDrive that runs faster than 166 MHz and will not be offering upgrades to the Pentium II architecture. The AMD K6 isn't as adept as the 266-MHz Pentium II, but it does match the performance of the Pentium Pro under Windows NT and that of the 233-MHz MMX Pentium under Windows 95.

Evergreen also has upgrades for your antiquated portable. Through a partnership with FedEx, the company is offering factory upgrades for 486 notebooks (486SX, SX2, DX, DX2, and DX4 models but not SLs) that double overall performance. For \$549, you can ship your portable to the company's Oregon factory and have it upgraded within 72 hours. A week turnaround costs only \$499. The upgrade chip, based on the AMD 586, performs on a par with the Pentium/75.—CM



DAN O'BRIEN
decathlete



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Medium- to large-size businesses rely on high-end accounting software to help balance their books. Filling the gap between such small-business products as Intuit's QuickBooks and extremely elaborate packages such as SAP's R/3 (which can cost upwards of six figures), these client/server-based accounting programs vary in price, depending on the number of modules and users involved.

Scala North America's **Scala 4.1** ranges in price from \$50,000 to \$100,000 (888-722-5241, www.scala.com). This cross-platform product runs under everything from Microsoft Windows 3.1 or later to Windows NT 3.51 and 4.0 and NetWare 3.12 or later.

The 32-bit product consists of 13 basic modules: General Ledger, Accounts Payable, Accounts Receivable, Order Entry/Invoicing, Marketing Database, Stock Control, Purchase Control, Project Management, Service Order Management, Statistics, Direct Invoicing, Scala Reports, and MPC (Manufacturing, Planning, and Control).

ACCPAC International (800-773-5445, www.accpac.com), a division of Computer Associates, builds upon last year's release of ACCPAC for Windows 2.0 with the release of **ACCPAC for Windows—Microsoft SQL Server Series**. The 16-bit package, which costs anywhere between \$2,500 and \$50,000, includes the following modules: System Manager (which comes with Crystal Info, an industry-standard report-writing tool that connects your data to the Internet), General Ledger with Financial Reporter, Accounts Receivable, Accounts Payable, and Payroll, as well as

fully integrated Inventory Control and Order Entry modules.

The SQL Server version provides a new data-analysis tool, BrioQuery Analysis and Reporting, that enables you to drill down within a record and lets you analyze virtually any ACCPAC for Windows data. In addition, it prints any report, schedule, or e-mail to the Internet and enables query and analysis via the Internet. The package runs under Windows 3.1, Windows NT 3.51, NetWare 3.12, and all of their successors.

Macola Software (800-468-0834, www.macola.com) has been

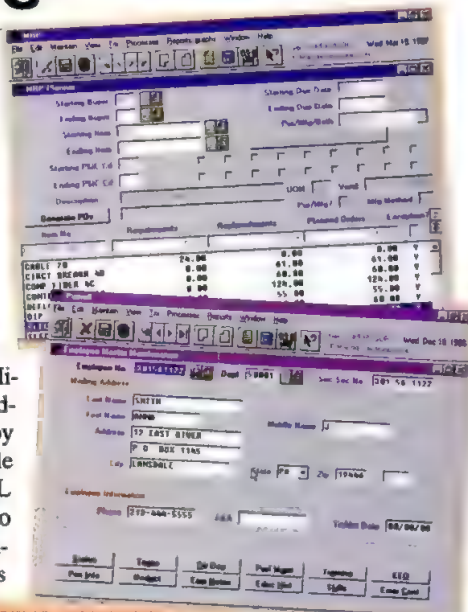
and Production Order Processing.

V7 Progression Series runs under both Windows 95 and NT 4.0.

Due out by this fall is version 2.7 of **Solomon IV for Windows**, Microsoft SQL Server Edition, from Solomon Software (800-476-5666, www.solomon.com). The Microsoft SQL Server product is intended for use by 25 or more users, while client and scalable SQL server versions are also available for smaller organizations. Pricing ranges from \$2,580 to \$11,520.

Solomon IV can come with any combination of the following integrated modules: System Manager, General Ledger, Accounts Payable, Accounts Receivable, Inventory, Order Processing, Customization Manager, R&R SQL Report Writer, Purchasing, Cash Manager, Currency Manager, Bill of Material, Payroll with Direct Deposit, Bar Coding, Project Controller, and Financial Statement Translation.

In addition to new features and functionality, this version introduces the first tier of Solomon IV's Internet support. Included in the package is Solomon IV WebAssistant, a browser-based suite of tools that allow employees to interact with the business, accomplishing such tasks as submitting time cards and accessing expense reports and requisitions. Also included is Web SelfServe, which uses the MAPI protocol to

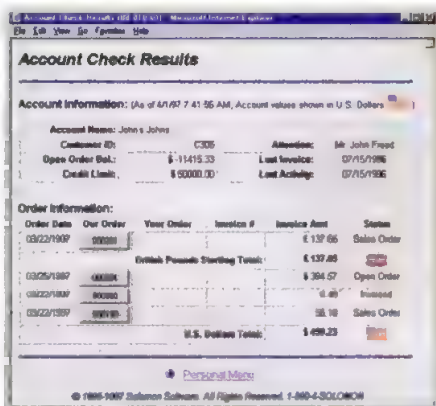


MODULAR PROGRESSION: Macola's Planning and Payroll modules.

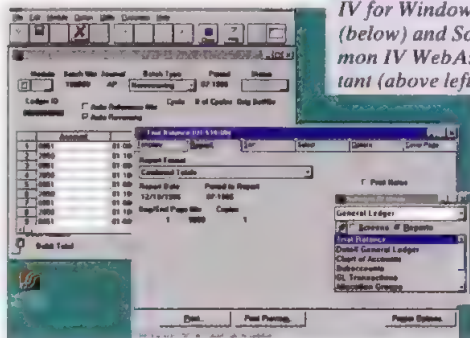
process and return remote report requests. Solomon IV runs under Windows 3.1 or later, Windows NT 3.51 or later, and NetWare 3.12 or later.

Navision Software US (800-552-8478, www.navision-us.com) is offering **Navision Financials 1.20**, an accounting tool that strays from the traditional modular approach taken by the other packages mentioned here. Instead, Navision uses what it calls "granules"—macro and micro functions—that the company customizes to specific preferences. These granules fall into 13 categories: General Ledger, Sales Order, Accounts Receivable, Accounts Payable, Purchase Order, Inventory Management, Bill of Material, Payroll, Resource Management, Job Costing, Foreign Trade, Human Resources, and Contact Management. The average cost of this package hovers around the mid-\$20,000 range.

Addressing Internet needs, Navision Financials now comes with hyperlink functionality. Navision runs under Windows 3.1 or later, Windows NT 3.51 or later, and NetWare 3.12 or later.—
Yvonne Koulouthros



busy enhancing and adding modules to its **V7 Progression Series** program, a package that generally costs between \$1,250 and \$3,000. In addition to the standard General Ledger, Accounts Receivable, and Accounts Payable modules, Macola has added Bank Book, Production Order Processing, and Currency Manager modules. The Order Entry, Inventory Management, Purchase Order and Receiving, and Bill of Material modules all feature new, customizable distribution functionality, such as multicurrency order processing. Other revamped modules include Payroll, Human Resources, Master Scheduling, Material Requirements Planning,



TWO VIEWS: Solomon Software's Solomon IV for Windows (below) and Solomon IV WebAssistant (above left).

Trends Peripherals

MASS STORAGE

Room to Grow

Need to squeeze six more months use out of your PC? Consider upgrading your hard disk.

You can easily add more capacity for those burgeoning applications and Internet downloads, and you can even upgrade to a faster model. The latest drives use technologies such as magneto-resistive (MR) heads and Partial Response Maximum Likelihood (PRML) to achieve disk capacities as high as 7GB. And a few have begun to support Ultra DMA, a protocol that doubles the burst data-transfer rate on ATA/IDE drives from 16.6 MBps (megabytes per second) to 33 MBps, which speeds sequential data transfers. You will feel the difference the most during your system's start-up or when loading large programs such as desktop video applications.

Disk drive progenitor IBM (800-426-2468, www.storage.ibm.com) is putting the finishing touches on its Ultra DMA-based drives, due out this fall. The **Deskstar 5** (pricing unavailable at press time) is a 3.5-inch Fast ATA-3 drive with a capacity of 6.4GB. A 4.8GB version will also be available. The 5,400-rpm drive

has a 128K multisegmented cache buffer (upgradable to 512K), a 5.4-MBps minimum data-transfer rate, and a 9.5-millisecond (ms) average seek time.

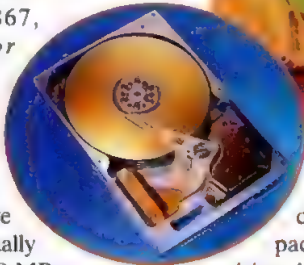
Boasting the highest capacity Enhanced IDE drive on the market is Maxtor (800-262-9867, www.maxtor.com). The **DiamondMax 1750** (\$500 street) is a 7GB, 3.5-inch, 5,200-rpm drive that has an equally impressive 6.9-MBps

minimum data-transfer rate, a sub-10-ms seek time, and a 256K cache buffer. The drives also come in 5.1GB, 3.5GB, and 1.7GB capacities. Ultra DMA versions of the drive are expected to ship by the end of this summer.

For the SCSI contingent comes Seagate's (800-732-4283, www.seagate.com) **Barracuda 4XL** drive (\$850 street), a 7,200-rpm model that uses an Ultra SCSI interface. Available in 4.5GB and 2.2GB versions, the Barracuda has a 10MB/second minimum data-transfer rate, an 8.8-ms seek time, and a 512K cache buffer.

JTS Corp.'s (408-468-1800, www.jtscorp.com) **Champion**

PACK IT IN: High-capacity hard disks from Micropolis (right) and Maxtor (below).



(\$300 street) is a 3.5-inch Fast ATA-3 drive with a 3GB capacity. This 5,400-rpm drive has a minimum sustained transfer rate of 5.3 MBps,

a 256K cache buffer, and a sub-12-ms seek time. 2.5GB, 2GB, and 1.7GB versions are also available.

Rolling out into the fast lane is Micropolis (800-395-3748, www.micropolis.com), which offers the **Mustang** (\$400 street), a 5GB Enhanced IDE drive. The 5,200-rpm model has a minimum data-transfer rate of 4.1 MBps, a 10.5-ms seek time, and a 256K cache buffer. The drive also comes in 4GB and 2.5GB capacities. The **Stinger** (\$550 street) is a 4.3GB, 5,400-rpm SCSI drive with a 4.1-MBps minimum sustained data-transfer rate, a sub-10-ms seek time, and a 512K segmented cache buffer.—Toni F. Kistner

SCANNERS

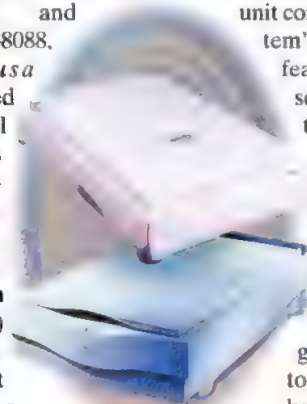
A Scanner on Every Desk

Choices abound in the color flatbed scanner market. New product lines from UMAX Technologies (800-562-0311, www.umax.com) and Plustek (800-685-8088, www.plustekusa.com) are geared toward entry-level SOHO users as well as the mainstream business and graphics set.

For a bargain, UMAX's **Astra 300P** (\$200 street) can't be beat. The parallel-port device includes a printer pass-through cable and bundles Adobe PhotoDeluxe, and Presto! Wordlinx for OCR. On the higher end is the **Astra 1200S** (\$450 to \$650 street, depending on the software bundle). This 30-bit, 600-dpi legal-sized scanner uses UMAX's Bit Enhanced Technology (BET) for improved image quality. The bundle includes a choice of either Adobe PhotoDeluxe or the full version of Adobe Photoshop 4.0.

If you want 30-bit color depth and 600-dpi resolution at an entry-level price, consider Plustek's \$299 **OpticPro 9630P**. The unit connects via your system's parallel port and features a letter-sized scan bed. Expected this summer is the tabloid-sized **OpticPro A3P** (priced at under \$1,000).

This 30-bit, 400-dpi model scans images up to 12-by-17 inches and generates OCR up to two 8.5-by-11-inch book pages. Both scanners include ExpressVision's TypeReader for OCR; for image editing, the 9630P unit comes with Micrografx PhotoMagic, while the A3P unit includes Micrografx PicturePublisher.—TFK

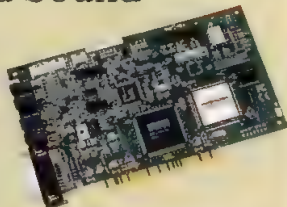


SCANNER RANGE: The *OpticPro 9630P* (top) and *Astra 1200S*.

SOUND CARDS

Real World Sound

Gamers and multimedia enthusiasts, listen up. Diamond Multimedia's (408-325-7000, www.diamondmm.com) **Monster Sound** PCI-based audio accelerator (\$200 street) is sure to deliver that one component that's been missing from your gaming experience: realistic sound. The board uses A3D Interactive audio from Aureal Semiconductor; the technology was originally developed for NASA virtual-reality simulators. Multistream positional audio and quad-speaker output add to the home theater-quality sound. Unlike other sound cards, Monster Sound works alongside your legacy-based ISA-bus or motherboard audio components, so you can continue to play DOS games as well as snazzy Microsoft Windows 95 titles. The bundled software includes Outlaws from LucasArts Entertainment, SimCopter from Maxis, and Tiger Shark from GT Interactive.—TFK



RECAP PC Magazine reviewed 17 color flatbed scanners in our March 4, 1997, issue. The UMAX Vista-S12 and Microtek ScanMaker III won the Editors' Choice.

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INTERNET TELEPHONY

A Phone Away from Home

Since most companies rely on long-distance calls to conduct business, it's imperative to find a thrifty phone plan. Internet telephony is an increasingly popular solution to expensive phone bills.

Telegate Internet Telephony Gateway, from Array Telecom (416-736-0901, www.telecom.array.ca), provides free long-distance calls via the company's Minute Bartering System. This software product, which starts at \$1,250 for a single line, switches calls from your organization's plain old telephone service (POTS) to the Internet. The software then compresses, packages, encrypts, and routes the long-distance portion of a call to a POTS line at the other end.

Thanks to this bartering system, you don't need to own gateways at both ends of the call. Companies can access Telegate from a private branch exchange (PBX) or an IP or POTS phone, and can send or receive calls from any H.323-compliant Internet gateway.

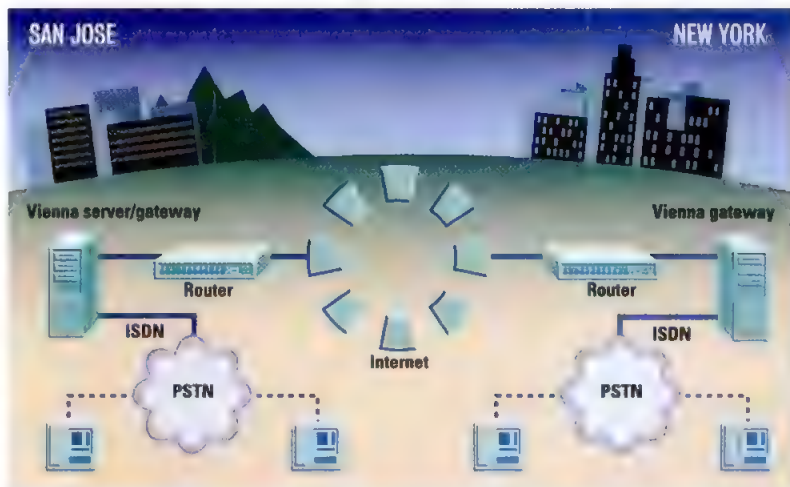
VocalTec's Telephony Gateway 3.0 is a scalable Internet telephony server that integrates voice and fax capabilities with configuration and security features (201-768-9400, www.vocaltec.com). Designed for corporate intranets, Internet-enabled call centers, and Internet telephony service providers, this software-only package routes calls or faxes between headquarters and branch offices through the Internet or corporate intranet. The Desktop Dialer enables corporate employees to access office voice mail remotely via the Internet and to place calls to anywhere in the world from a PC.

Telephony Gateway costs \$1,350 for a single voice line and \$999 for a fax line, with upgrade

discounts available. Each line can be configured separately as an internal PBX extension or as an analog or digital trunk line.

For very high-end corporate users, **Vienna Systems Corp.** (613-591-3219, www.viennasys.com) offers **Vienna.way**, a customizable solution providing

hardware and software package bypasses toll calls by routing the calls to the closest IP gateway, then across the Internet to the closest local central office—resulting in a simulated local call. **Vienna.way** enables users to share data and audio during conference calls.



LONG-DISTANCE LIFE: The Vienna.way system helps cut back on telephone bills.

functionality similar to a PBX but using TCP/IP networks for transport. Companies using Vienna.way do not need Internet access to use the network for long-distance calls; instead, this

Pricing varies according to a network's specifications, but an entry-level package (installed and maintained by Vienna Systems) for 16 connections generally costs around \$12,000.—*Brett Krasnowe*

SEARCH SOFTWARE

Fact Finders

With corporate intranets, legacy data, and the Web, the amount of information to sift through continues to expand dramatically. Having powerful tools to help you find what you need is becoming ever more important. Three new, free search services can help untangle the mess.

Many companies need a way to reconcile their important legacy data with intranets and the Internet. With that need in mind, **ISYS/Odyssey Development** (800-992-4797, www.isys-dev.com) designed Version 2 of its **ISYS:web** search-and-retrieval software (\$5,200 per server; unlimited clients) to function as an HTTP Web server that publishes

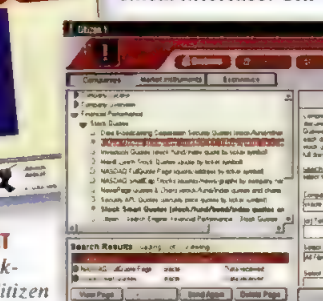


THE GREAT NET SEARCH: LookSmart and Citizen 1 help you sift through the Web.

legacy documents on the Web automatically. ISYS indexes over 40 native file formats, from Adobe PDF documents to Microsoft Excel spreadsheets, and dynamically converts them to HTML format.

Citizen 1 Internet Tool, a free

download from the Citizen 1 Software site (415-882-9404, www.citizen1.com), saves you time by organizing the best of the Web into an easy-to-use, hierarchical interface. Citi-



zen 1 IT primarily looks for databases, the entirety of which you can search via keyword. Other search tools, such as Infoseek and Yahoo!, only index HTML. The company also offers Citizen 1 Healthcare Internet

Tool for an annual fee of \$1,500; discounts are available for multi-seat licenses and nonprofit organizations.

Need personalized attention? Ask **LookSmart** (415-328-5555, www.looksmart.com). During the academic year, this Java-based search engine offers Ask Professor Fergus, a homework-helper service for everyone from grammar to graduate school. Send in a query, and

you'll receive an e-mail detailing the best places to look on the Web for information. You can expect a response within 24 hours from LookSmart's team of editors and experts.—*Karen J. Bannan and Regina Kwon*



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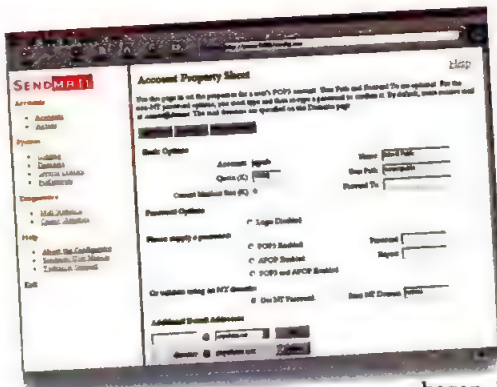
You Have New Mail

In the rapidly changing world of the Internet, even e-mail—a reliable old workhorse—is undergoing change. A new crop of e-mail servers adds support for the relatively new IMAP4 protocol to their POP3 services. IMAP4 (Internet Message Access Protocol) is more sophisticated than the older, more basic POP3 (Post Office Protocol), allowing replication for mobile users, selective message downloading, and shared folders on the server.

Qualcomm (619-587-1121, www.eudora.com), maker of the popular Eudora family of e-mail client software, enters the server market with **Eudora WorldMail Server** for Windows NT. This IMAP4 and POP3 server is available in a bundle with the Eudora Pro client. Pricing starts at \$825 for a 10-user package; bundles are available for as many as 500 users, along with add-on packs.

WorldMail uses the Lightweight Directory Access Protocol (LDAP) to store user names, e-mail addresses, and other data. Following an increasingly common trend, WorldMail's management interface uses HTML and Java to allow simple administration to anyone with a browser from anywhere on the Web. WorldMail also features some of the other staples of e-mail servers, including the ability to create and modify mailing lists and to control user access at several levels.

Not to be left behind, Ipswitch (617-676-5700, www.ipswitch.com) has announced **IMail Server 4.0** for Windows NT. The new version also features support for both LDAP and IMAP4, on top of POP3. Version 4.0 (\$495 for server and ten clients) improves several of IMail's features, including the



BROWSE CONTROL: Sendmail now features an HTML-based interface for easy management.

List Server, which has been extended to encompass a digest mode, private lists, improved security, and more.

Perhaps the most unique new IMail feature is its anti-spamming filter. IMail allows you to block mail that does not come from local users or isn't addressed to them, preventing bulk mailers from using SMTP to take advantage of your server. You can also define systems from which you never want to receive mail, such as bulk e-mail servers that are known to send spam.

Sendmail, another well-known name in the world of e-mail, began life on Unix and was later ported to Windows NT by MetaInfo (206-674-3700, www.metainfo.com). Priced at \$495, **Sendmail 2.0** for Windows NT features a graphical user interface—a major improvement over the previous Win-

dows NT version of Sendmail, which required administrators to know Unix command-line codes. This version, however, supports only POP3; MetaInfo plans to include IMAP4 eventually in a future release.

Like WorldMail, Sendmail's new interface is HTML-based. This allows administrators to set up and manage the server from a Web browser. Other improvements include controls for POP3 storage limits and a context-sensitive help file. Sendmail features a DNS server, and the package includes a license for unlimited users and unlimited domain names. —David R. Lambert

RECAP PC Magazine reviewed MetaInfo's Sendmail 1.1 and Ipswitch's IMail Server 3.04 as part of the groupware feature in our issue of May 27, 1997.

WIRELESS ROUTERS

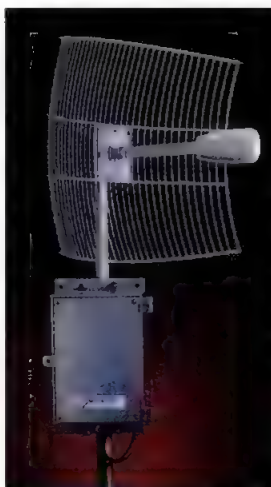
Networks on the Air

Connecting various segments of your campus network can be difficult when you don't own the campus.

Before wireless technology, you had the choice of either renting a leased line from your local telephone company or purchasing right-of-way from multiple sources to run wires between sites. Now, several vendors are offering wireless routers with speeds approaching—and sometimes exceeding—T1 speeds (1.544 Mbps).

Cylink Corp. (408-735-5800, www.cylink.com) currently offers two different versions of its DataMetro

product: the **DataMetro 1280** (starting at \$3,995), which provides throughput of 1.28 Mbps, and the \$2,995 **DataMetro 320**, which provides a throughput of 320 Kbps. Both devices support IP and IPX routing and are SNMP manageable. Both can support point-to-point, star, and peer-to-peer network topologies.



CATCH THE WAVE: WaveNet IP's wireless connection eliminates the cost of leased circuits and right-of-way in connecting your campus network.

The **WaveNet IP** from Multipoint Networks (415-595-3300, www.multipoint.com), as its name implies, supports only native IP routing. Designed to be an access router, the WaveNet IP (which starts at \$2,700) offers an HTML-based

interface and a few security features. The router uses a unique frequency-hopping pattern and a proprietary protocol to secure radio transmission. Also, each central router has a list of all the edge routers' MAC addresses, and each will communicate only with those routers.

The **AirLan/Router200** solution from Solecetek Corp. (800-437-1518, www.solectek.com), codeveloped with Cisco Systems, supports both Ethernet with the **AB200-E** (\$2,995) and Token-Ring with the **AR200-T** (\$5,995). Each router comes with IP and IPX routing, Cisco's IOS, SNMP MIB II support, and also three user-selectable radio-frequency channels.

Finally, the **SubSpace 2002 Wireless MAN** systems from TAL Wireless Networks (408-523-8000, www.tetherless.net) offers a two-part wireless solution in a star topology. The \$2,349 Access Point at the central site and the Remote Client (starting at \$1,149) at the remote location provide TCP/IP routing. A 128-bit encryption option is also available for added security. —Robert Daly

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First Looks



A New Era of Video Editing

Four affordable apps bring video editing to the masses.—By Jan Ozer and Luisa Simone

Digital video is everywhere. A number of factors are driving this emerging market. Foremost is the availability of increasingly powerful and affordable hardware. There is also a significant overlap of people who own multimedia PCs, camcorders, and digital cameras—devices that provide the raw material for digital editing. The leader in digital video-editing software is Adobe's Premiere, but at a list price of \$795 it likely won't penetrate the mass market anytime soon.

We found four programs—Asymetrix Digital Video Producer, Corel Lumiere, MGI VideoWave, and Presto! VideoWorks—that not only offer robust editing capabilities but also cost less than \$150. A fifth pro-

gram, Jasc Videotrope, arrived too late to be included in this roundup, but we added a sidebar review, "Digital Workshop's Videotrope."

SUPPORTING TECHNOLOGIES

A host of technologies offer system-level support and promise to reduce rendering times—a major obstacle to digital video editing. These include Intel's Pentium processors with MMX Technology, and its Animation, Image Processing, and Realistic Sound Experience libraries that can be implemented for MMX-enabled CPUs. You will also see more video editors supporting Microsoft's rendering technologies, such as Active Movie and Direct3D. DVP's preview

functions, for example, are all based on Active Movie.

OBSTACLES

There are three hurdles that digital video editing must overcome in order to transform itself from a specialized art into a broad-based communications tool: price, ease of use, and performance. With products available for as little as \$40 on the street, we've already cleared the first hurdle.

As usual, ease of use often comes down to interface design. High-end and high-cost products such as Adobe Premiere provide a broad range of powerful features. We don't expect the programs in this roundup to beat those products at their own game. Nevertheless, we created specific tests to evaluate the products based on our experience with high-end programs.

On the most basic level, we expect programs to capture video at a reasonable resolution and data rate without dropped frames. We also look for them to write correctly interleaved video and audio with specified frame rates, data rates, and keyframes.

We also tested the programs' editing and special-effects functions. We looked at standard A/B rolls and the precision with which each program could synchronize audio and video. We also evaluated transitions, motion effects, and timing sequences.

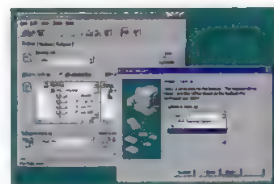
We can tell you how well each program performed. But only you can weigh that performance in light of your own production needs and creative impulses.

Asymetrix Corp.

Digital Video Producer

Though a retail version of Asymetrix Digital Video Producer 5.0 will soon be on the market, chances are very good that

INSIDE



BRING IN BACKUP: Seagate Backup Exec 95 is the cream of the Windows 95 backup crop. For the full review, see page 66.



BLASTOFF: Creative Labs blows you away with the Sound Blaster AWE64 Gold. See page 58.

DIGITAL CAMCORDER: Hitachi's MP-EG1A is a compact way to capture digital video, stills and audio. See page 73 for the review.

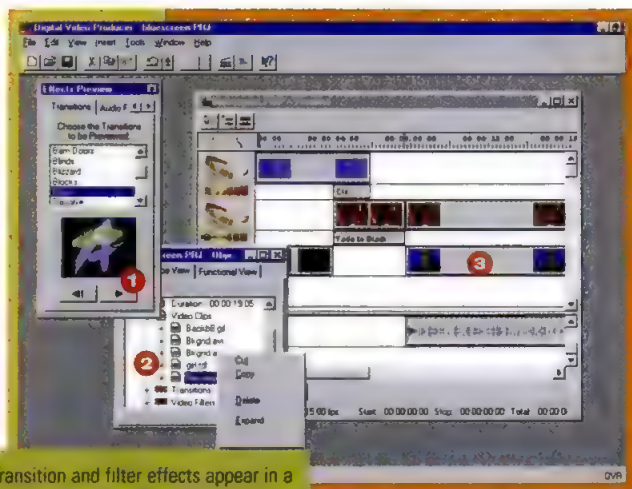


MINI-MAGIC: Toshiba's Libretto 50 may be the answer to your palmtop prayers. See page 63.

More Products Reviewed . . .

IBM ThinkPad 560E	62
Toshiba Portege 300CT	62
FutureTense Texture 1.1	70
Compass	76
Etak SkyMap	76

First Looks



- 1 Transition and filter effects appear in a floating, tabbed palette.
- 2 Right-clicking an entry in the Object Browser lets you change properties or jump to a specific file on the timeline.
- 3 DVP can display filter effects as tracks. Clicking the minus button hides the track.

thousands of small-business, corporate, and home users will receive the program bundled with a low-cost video-capture card. In fact, this review is based on the OEM version of the product.

Previously shipped as a suite of standalone programs, Digital Video Producer (DVP) now lets you access all essential functions from the core program. DVP's capture features remain simple but functional. Via MCI support, the program can automatically capture in-step, real-time, or batch modes from laserdiscs and VISCA decks, but it can't advance or rewind the source deck. DVP captured our test video without dropping frames, but only after we turned off capture preview. Although capture was normal, DVP often crashed when saving large capture files.

DVP has always offered an SMPTE timeline, but it now lets you add any number of video or audio tracks to a project. The working environment includes player windows, a Library, and an Object Browser.

Though each of these interface elements works well enough alone, they fail to work well together. For example, double-clicking a clip in the timeline

doesn't automatically open a player window. Editing the clip in the player doesn't automatically update the duration of the clip in the timeline. Most confusing of all, importing an .AVI movie into the Media Library separates the video and sound portions of a file, forcing you to import the files separately and sync them manually.

Most users will want to disable both audio and video bitmaps, which complicate timeline edits. DVP can import a wide variety of file formats, but the OEM version of the program omits import filters for two important formats—FLI/FLC animation files and JPEG images.

The program is also seriously hampered by its preview functions. Though preview wasn't oppressively slow—it took 24 seconds for a one-second cross-dissolve—other characteristics limit preview effectiveness. You can't preview audio and video together, so it's useless for synchronization. The maximum preview window size is 240-by-180, so detail is minimized. And because DVP merely passes data to the Active Movie driver, previews are rarely in real time, making it tough to gauge time-sensitive effects. Most users will need to compress to final output in order to gauge effects, a serious limitation given DVP's inability to compress partial clips.

DVP offers sophisticated

editing tools, such as virtual clips, slice, ripple, and rolling edits found in higher-cost products. A bug (which Asymetrix knows about) prevents the ripple and rolling edit tools from working properly when you are shortening the first file in a sequence of clips.

In many instances, the program's interface provides easy access to advanced functions. Right-clicking a clip, for example, brings up a tabbed dialog box where you can create transparent overlays, implement chroma-key effects, or assign one of the 18 video or 4 audio effects filters. In other instances, that same interface is an obstacle to quality work. For example, the program never uses the source videos for dialog box previews, which forces you to use proxy images instead. We wish the filters offered more configuration options, such as start and end values to vary the

effect of filters over time. We were impressed with the overall quality of the effects, including great dissolves and soft edge wipes. But DVP still doesn't antialias chroma-key overlays. Another new feature—alpha channel transparencies proved buggy, causing a color shift in imported TIFF files.

DVP offers 2-D and 3-D motion controls in a key frame-based system with six predefined motion paths. You define a path by creating a key frame and moving a token bitmap—not the actual asset—to the desired location. Omissions such as the inability to specify location, spin, or rotation values make operation frustrating, but output quality was very polished.

Using TrueType fonts, DVP's titling module functions as a mini-modeling program, allowing you to generate 2-D or 3-D text. Preset motion paths guaran-

SUITABILITY TO TASK: VIDEO EDITORS



	Digital Video Producer	Corel Lumiere	MGI VideoWave	Presto! VideoWorks
POWER				
Capture	Fair	Poor	Excellent	Poor
Basic Editing	Good	Good	Good	Fair
Advanced Editing	Fair	Fair	Fair	Fair
Output	Poor	Fair	Good	Good
EASE OF USE				
Capture	Good	Fair	Good	Poor
Basic Editing	Fair	Good	Excellent	Good
Advanced Editing	Fair	Good	Excellent	Good
Output	Fair	Fair	Excellent	Good

CAPTURE The program should be able to generate correctly interleaved audio and video. The score increases if there are convenience features offered, such as a clearly designed interface or the ability to place a captured file directly into a project window. We also looked for batch processing and device control. **BASIC EDITING** This category comprises the core tools of any video editor. It includes the ability to perform A/B rolls with transition effects as well as rolling and ripple edits and the ability to split a video at a designated point. A program scored extra points if it provided precision editing tools. **ADVANCED EDITING** We looked at the toolset offered and its implementation. We also looked at the quality of the results and whether the program provided a variety of special-effects filters. Finally, we looked at how well these functions work. **OUTPUT** We output the .AVI movies using standard codecs Indeo Video Interactive (IVI) and Cinepak. The final movies were examined to see if the program correctly interleaved audio and video and if it compressed the file in a reasonable amount of time.

tee good results for novice users. The Star Wars preset, for example, generates rolling credits automatically. The titling module employs the same motion controls (with the same limitations) as the motion filter.

At output time, DVP couldn't reliably produce the requested bandwidth with any codec, with frame size rising and falling with clip complexity (Asymetrix is working on this problem). Since bandwidth largely determines file quality, it's unfair to compare DVP with other editors, although DVP's Indeo 3.2 files were clearly suboptimal in quality. We also noticed that files compressed with Intel's IVI lost synchronization when certain features were enabled.

DVP doesn't live up to its potential to deliver powerful video-editing tools and great-looking video effects at an affordable price. Even though we believe that Asymetrix will fix the problems we encountered, inconsistent performance and poor output make this version of DVP hard to recommend. **Digital Video Producer 5.0** OEM version (retail price not available). Requires: 90-MHz or faster Pentium CPU, Microsoft Windows 95 or Windows NT 4.0, 16MB RAM, 20MB hard disk space, SVGA graphics adapter, CD-ROM drive, Asymetrix Corp., Bellevue, WA; 800-448-6543, 206-462-0501; www.asymetrix.com. Circle 409 on reader service card.

Corel Corp.

Corel Lumiere

Corel Lumiere 1.0 targets cost-conscious digital video producers by mimicking the look and feel of Adobe Premiere at a fraction of the price. But although the names rhyme, Lumiere can't match Premiere's performance in several critical areas.

For example, our tests showed that Lumiere's integrated capture features were extremely basic, with an awkward interface. Sev-

eral poor design decisions make certain operations unwieldy (such as re-interleaving captured files while storing them to disk). Other programs simply change the name of the captured file for instantaneous storage. Moreover, while Lumiere captured test files without a problem, it couldn't load them after storage, though the files loaded normally into other programs. On the whole, capture performance was inadequate.

Upon starting a new project, Lumiere displays an SMPTE timeline, where you can add as many video or audio tracks as you require. Transitions, a media catalog (where you store the clips used in a project), audio and video controllers, and the preview window are all implemented via Corel-style roll-ups.

Lumiere can import a wide range of video, audio, and graphics file formats. The import dialog box offers several enhancements, including the ability to crop or resample media.

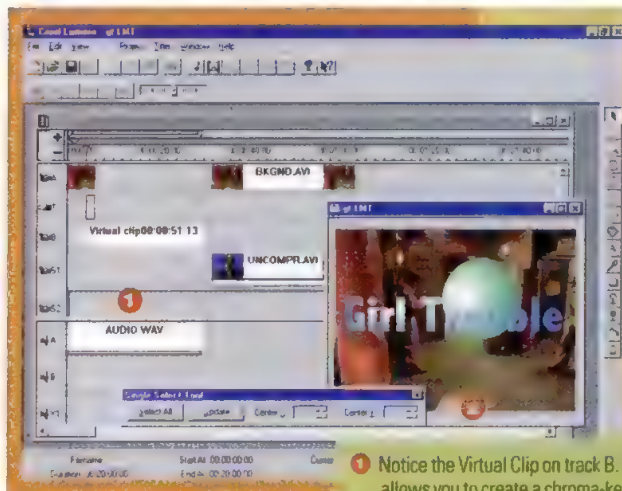
Lumiere loaded files slowly with bitmaps enabled, primarily because it uses extremely detailed waveforms to represent audio on the timeline.

For the most part, the program's basic editing tools are robust and efficient. The toolbox

functions—razor cuts, linking clips, punch-in and punch-out points, and single- or multitrack move—all work as advertised. You can even use Virtual Clip to treat a selected portion of the timeline as a single clip.

Synchronizing elements in a

ample, double-clicking a clip on the timeline brings up the appropriate controller, where you can designate punch-in and punch-out points. The effects of your edits are automatically reflected in the timeline—for video only. The length of the linked audio



- 1 Notice the Virtual Clip on track B. It allows you to create a chroma-key overlay (the two clips that follow the end of the project are the original source clips) and still apply a transition effect between tracks A and B.
- 2 Lumiere's titling window lets you preview text and geometric shapes against a source frame.

project was a snap, thanks to markers that can be added either to a clip or to the timeline itself. We also liked the ability to fade video or adjust audio volume interactively on the timeline. Though not labeled as rolling and ripple tools, those functions are provided as special paste and deletion commands.

Unfortunately, the tools don't always work consistently. For ex-

files remains unchanged, forcing you to edit the audio manually as a separate controller or to trim heads and tails directly on the timeline.

Editors' Choice

• MGI VideoWave



The good news with these five software packages is that you

don't have to break the bank to try your hand at digital video editing. They may not afford the same flexibility as much more expensive products, but for casual home or business use, they're all quite acceptable.

Our favorite is MGI Software Corp.'s VideoWave. Priced on the street at just \$100, VideoWave leads the pack in ease of use for basic and advanced editing, capture, and output. The

product's performance is also excellent: It captured our test video sequence without dropping any frames, and it successfully renamed the clip without difficulty or delay.

Although VideoWave's support for animation and audio is limited, its support for movie formats is impressive. With VideoWave, you can read and write .AVI, QuickTime .MOV, and software MPEG files as well. VideoWave is also the only package in this roundup with software MPEG encoding capabilities, as well as support for the leading streaming video codecs from Iterated Systems, VDO, VX-treme, and Vivo. The product is coded to take advantage of MMX instructions in Pentium and compatible processors; we'd suggest running it on an MMX machine, as you'll see a performance gain, especially when previewing your work.

First Looks

If you're looking for tons of transitions and filter effects, Lumiere may be impossible to resist. There are 70 transitions and 66 filters, making it easy to jazz up a video. The transitions offer useful customization options that include antialiasing for circular or diagonal wipes. The powerful filters allow you to correct problem videos and apply artistic effects.

Lumiere offers comprehensive 2-D motion controls with key frames and a variety of useful presets such as twirl and bounce in. It uses subpixel rendering to good effect, with significant jaggies appearing in only one or two test frames.

The titling module supplements support of both TrueType and Type 1 fonts with basic drawing functions. You can add geo-

metric shapes and fill objects with solid colors or gradients. You can even preview your title against the actual source video. But it took several adjustments of the antialias settings to achieve quality text superimpositions over the source video.

During testing, we uncovered several more serious shortcomings. Most troublesome is that Lumiere doesn't build a temporary file during preview. Although Lumiere produces near-real-time previews of extremely simple movies, it slows considerably with intense functions such as transitions and special effects. It also slows down when resolution increases. Because there's no temporary file, subsequent playbacks are jerky and never rendered in real time.

Lumiere also previewed audio out of sync with video—a situation that forced us to render a portion of our movie and use the Windows Media Player for accurate previews. When working with larger files, certain transitions (such as the Curtain Wipe) are not previewed properly. In addition, since you don't select the codec you finally render, the preview doesn't include compression effects, reducing its utility for codec/data rate decisions.

Lumiere offers the widest variety of key types (including chroma, luminance, RGB difference, image mattes, blue screen, and green screen). But we learned that where antialiasing is concerned, less is more. Lumiere's chroma-key effect

consistently produced a blue halo around the foreground image until we turned off antialiasing in the Options dialog box and smoothing in the Transparency dialog box.

Lumiere performed well on our compression benchmarks, producing high-quality Indeo video interactive, Indeo 3.2, and Cinepak files with average compression times. But Lumiere's compression controls are primitive at best, with no controls for CD-ROM padding, palette handling, or key frame placement. Also, Lumiere didn't recognize any of the low-bandwidth codecs on our system and couldn't compress to VDO format.

It's no surprise that the Lumiere box includes lots of extras. PhotoPaint 6 is a full-featured

Digital Workshop's Videotrope

Jasc, the company that broadened the image-editing market by selling Paint Shop Pro for only \$69, is poised to set a new price point for digital video. Digital Workshop's Videotrope (Jasc is the U.S. distributor) will list for \$49 and will sell in stores for as little as \$40.

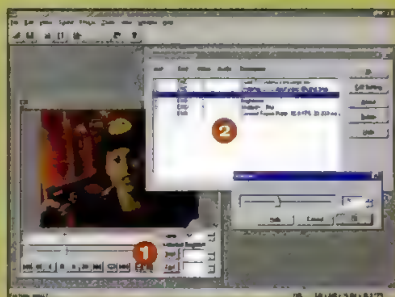
Price is critical, because it explains Videotrope's minimalist approach to video editing. Unlike the other programs in this roundup, Videotrope does not offer capture functions, motion effects, or a titling module. It doesn't even have basics such as A/B rolls with transitions.

Videotrope can open .AVI movies, .FLI/.FLC animations, and .WAV sounds. It supports .BMP, .TGA, and .PCX files, a subset of still-image formats whose narrow range limits the ease with which users can incorporate images from commercial clip-art libraries, digital photographic processing services, and the Web—all of which typically rely on other formats. The good news is that the program opens files almost instantaneously, because it does not display multiple frames or audio waveforms in a SMPTE timeline.

The interface consists of multiple playback windows. You use a single interface convention to play movies, set in/out

points, and apply special effects. You can work on audio and video simultaneously or separately.

Videotrope does a lot of hand-holding. If you try to join two videos of differing resolutions or frame rates, the program



1 You can designate whether video, audio, or both can be edited in the trimming window.

2 The processing list lets you alter any action you've taken during the current work session, generating nonsequential partial undos.

will prompt you to choose the source or target video as your project format and will automatically reconcile the conflict. The program can handle only a single stream of audio and video in each playback window, which means it can't overlay two videos or mix two audio tracks.

Like Presto! VideoWorks, Videotrope does not save a project file—saving makes

all of your edits permanent. In the current session, Videotrope stores all of your changes as part of a processing script, which lets you select an action in the list and modify it before you save the file.

Videotrope offers 16 basic filters (11 image and 5 audio), which can be applied to an entire clip or a selected segment.

Previews begin immediately, show all filter effects, and include audio, but they are rarely in real time. Videotrope actually monitors preview performance and will suggest that you render in order to get a better idea of the movie's pace. The high point of our testing came at output time, when Videotrope generated an Indeo Video Interactive movie near the specified data rates with keyframes at the appropriate intervals.

Videotrope's many editing limitations prove that a bare-bones editor at a bare-bones price isn't always a bargain.—LS
Digital Workshop's Videotrope. List price: \$49. Requires: 486DX2/66 processor or faster, Microsoft Windows 95 (8MB RAM) or NT 4.0 (16MB RAM), 5MB hard disk space, SVGA graphics adapter, CD-ROM drive. Jasc Inc., Eden Prairie, MN; 800-622-2793, 612-930-9800; www.jasc.com. Circle 413 on reader service card.

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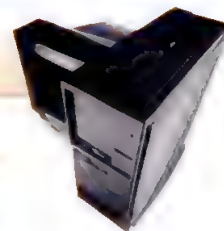
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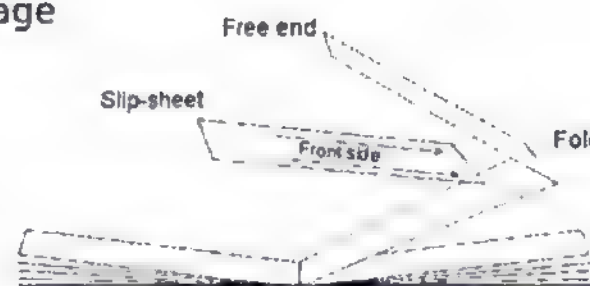
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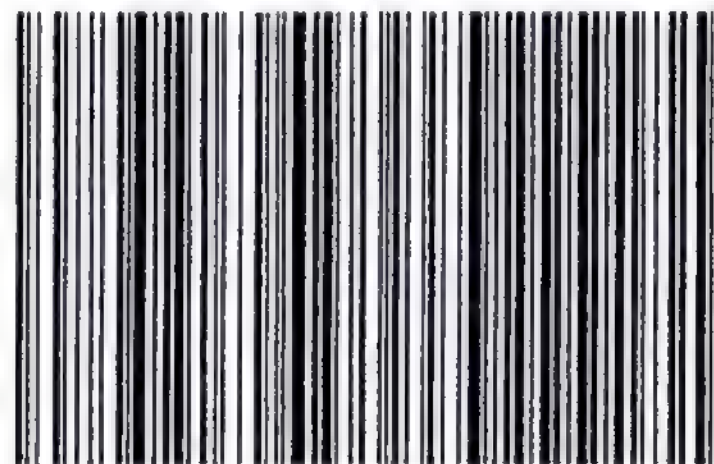
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Foldout slip-sheet



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Inverted Foldout slip-sheet

Folded edge of the page

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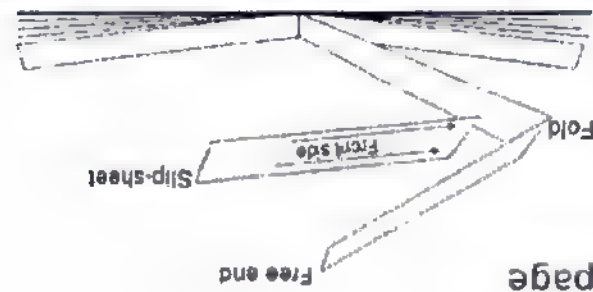
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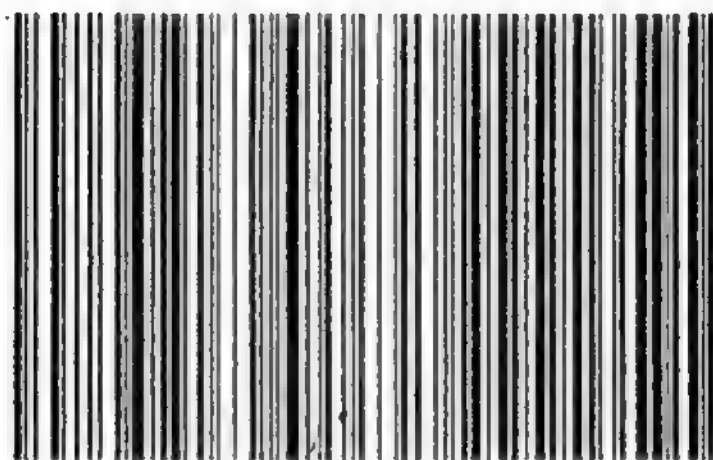
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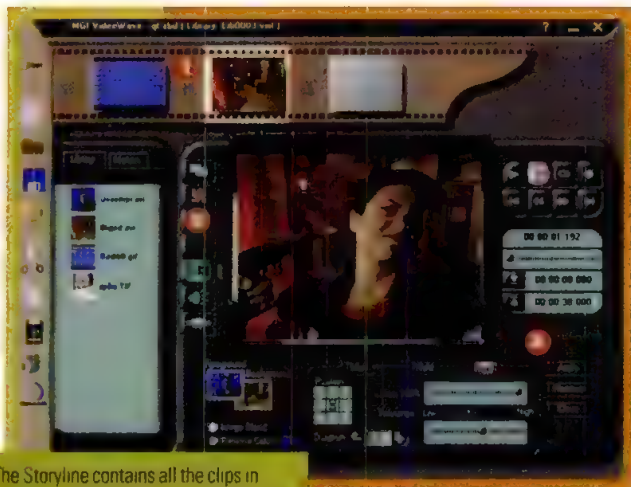
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First Looks



- 1 The Storyline contains all the clips in your movie. Notice the icons for transition effects.
- 2 Mode buttons switch between the various editing modules. Here, Video Animation is selected.
- 3 The context-sensitive control panel displays tools and customization options for the current function.

image-editing program and Corel Motion 3D allows you to create animations far beyond the capabilities of Lumiere's built-in titling and motion modules. A small integrated app, the Smart Sound Wizard, generates audio clips from generic canned music and sound effects with an important advantage—it allows you to specify the exact length you need to match your video clip. Over 150 videos, more than 60 minutes of music clips, and thousands of still images round out the bundle.

We were impressed with many of Lumiere's internal editing tools. But when it comes to input and output, Lumiere is a first-generation video-editing program in need of improvement.

Corel Lumiere Suite Version 1.0 Street price: \$70. Requires: 100-MHz or faster Pentium CPU, Microsoft Windows 95 or Windows NT 4.0, 16MB RAM (32MB recommended), 53–126MB hard disk space, VGA graphics adapter, 2X CD-ROM drive, Corel Corp, Ottawa, Ontario, Canada; 800-772-6735, 613-728-3733 www.corel.com. Circle 410 on reader service card.

MGI Software Corp.

MGI VideoWave

MGI Software Corp.'s VideoWave is planning a big splash in the home video market with a unique interface that simplifies the editing process. VideoWave eschews the traditional multi-track, timeline-based interface. Instead, it provides a single window where you set in points for clips; apply filter effects and transitions; create titling, motion, and overlay effects; and preview your movies.

MGI can squeeze all this functionality into the central View Screen by using function buttons found along the side of the screen. A special control panel beneath the main viewing area changes to display the appropriate tools and options for each mode. For example, clicking the Text Animator button brings up a text entry window with formatting options for font, point size, and alignment.

The most interesting feature of VideoWave's interface is the Story Line, where thumbnails of the first frame of each clip in a movie are sequentially linked together by transitions. Fixed areas of the screen display VCR-like controls for playing movies, a toolbar for basic file and clipboard operations, and a tabbed palette where you can access media clips, filters, and transitions. Amazingly, you can edit an

entire production without accessing a single dialog box, thanks to radio buttons, slider bars, and the ability to drag and drop elements.

VideoWave's capture features are well designed and highly functional. After capturing from the main program screen, these files are automatically inserted into the clip library. Performance was excellent: VideoWave captured our test sequence without frame dropping and renamed the clip without difficulty or delay.

The program supports an impressive array of movie and image formats with the ability to read and write .AVI, .MOV, and MPEG. Animation and sound support is limited; VideoWave can't import FLI/FLC animations or any sound format other than .WAV. Since VideoWave does not have a timeline to draw the audio and video bitmaps, file load times are extremely fast.

If you're planning simply structured videos, you will find VideoWave a pleasure to use. The 28 transition effects have a single customization option for duration. Corrective filters, which include Brightness and RGB adjustment sliders, are part of the trimming window. Nine artistic filters provide easy-to-access start and stop values to vary effects over time.

These tools have some intrinsic limitations, though. Transitions are not antialiased—a shortcoming that may not be noticeable because all of the transitions are simple 2-D wipes with very few of the diagonals or curves that require softening. And you can only apply one filter to each clip. We'd also prefer a few more corrective filters, such as crop or de-interlace.

VideoWave's 2-D motion controls, whether accessed from the Text Animator or the Video Animator, are very basic. For example, they don't include the ability to spin our test image around a 360-degree axis. You are given three positions (start, hold, and end) for which you can change such attributes as transparency,

color, and size. Instead of a user-defined path, you simply click one of nine possible positions on a proxy grid. According to the vendor, the program doesn't perform subpixel rendering or antialiasing, which caused obvious jaggies on our informal tests of 2-D motion.

VideoWave isn't intended to be a precision-editing tool. The program can't display SMPTE time code (which uses milliseconds instead of frame numbers to indicate units smaller than one second). Nor can you insert markers into a clip to sync audio and video accurately.

Unfortunately, chroma keying and audio editing haven't really been thought out. The inability to pick a color for chroma keys from the source video (or to define a custom RGB color) yielded poor results on our computer-generated blue-screen background, though the program does a better job when working with photographic backdrops. Also, it's impossible to set audio in/out points or cut and paste audio between scenes in the Story Line. Each video clip can be associated with a maximum of three audio tracks. So when overlaying two clips, you maintain the audio for the background clip but lose the audio in the foreground clip.

You can preview a scene or any contiguous assets on the timeline by highlighting them with your mouse. Both preview modes let you choose either to show all frames, which plays each frame without audio, or play in real time, which drops frames but plays the audio. Unless your PC has an MMX-enabled processor (which VideoWave supports), you'll find that you must switch between these two preview modes to achieve the highest visual accuracy or a better sense of timing. Since the program doesn't create a temporary file, all previews are in nonreal time. During preview, however, you can step through the video using VideoWave's playback controls. This allows you to scrutinize carefully



1. Cable and internet connection must use hardware equipment to be used with this computer with any standard 10/100/1000 Ethernet internet access software.

2. All x2 products are capable of downloading data to a hard drive. Computer with limited power output (current download speeds are limited to 5.5 Mbps). Actual speeds may vary. See www.usr.com/x2 for details.

3. Actual performance subject to network speed and internet traffic.

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First Looks

all of the frames.

VideoWave presents compression controls in a logical, wizard-like manner that walks you through all basic compression decisions. Compression performance was solid, with VideoWave producing high-quality IVI, Cinepak, and Indeo 3.2 files at or near the specified data rates in average compression times, although compression to IVI format produced a slight loss of audio/video synchronization. VideoWave was the only editor in this roundup to ship with software MPEG encoding capabilities as well as codecs for the leading streaming video codecs from Iterated Systems, VDO, VXtreme, and Vivo.

If you're willing to accept a limited toolset in exchange for a nearly self-explanatory, truly beautiful drag-and-drop interface, MGI VideoWave is the program to buy.

MGI VideoWave Street price: \$100. Requires: 486DX2/66 or faster CPU, Microsoft Windows 95, 16MB RAM (32MB recommended), 20MB hard disk space (100MB recommended), 16-bit graphics adapter, 4X CD-ROM drive, 16-bit sound card MGI Software Corp., Richmond Hill, Ontario, Canada; 888-644-7638, 905-764-7000, www.mgisoft.com. **Circle 411** on reader service card.

NewSoft

Presto! Multimedia Suite 1.5a

Like a magician that keeps pulling rabbits out of a hat, the Presto! Multimedia Suite offers the home enthusiast a number of image-editing applications, including Presto! VideoWorks, Presto! PageManager, Presto! Image Folio, Presto! Media Player, Presto! MediaClips, and a special edition of Kai's Power Goo from Metatools. So in addition to video editing, you can scan

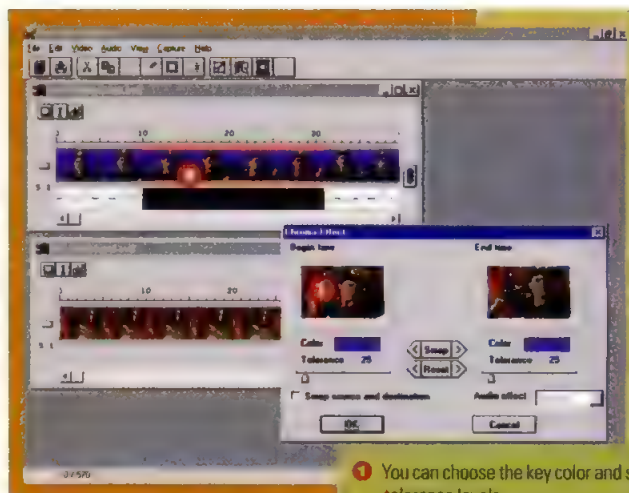
documents, edit still images, play music or software MPEG CDs, use over 400 media clips, and create zany special effects.

VideoWorks' simplified interface quickly loads each video clip into its own Media Player-like window, which can be toggled to a timeline mode for editing. Though you can't disable the audio or video bitmaps in Presto's timeline, program operation is very responsive. Presto defaults to a frame-per-frame view (which completely displayed in under one second), and shifted to a 1-fps view in a sprightly 1.8 seconds. Though you can work with a frame count or time increments on the timeline, VideoWorks does not support SMPTE time codes.

Opening large or multiple .AVI files produced messages warning us that system resources were depleted and that some editing operations could not be completed. This is probably attributable to the fact that the program is written in 16-bit code. Not surprisingly, Presto totally bogged down in our 30-fps capture tests, dropping a significant number of frames, distorting capture statistics, and abruptly crashing before completing the test (it did capture at 15 fps without problems, however). Capture features were limited, with no machine control or batch capture. Also, the interface felt disjointed, with options spread over a number of disparate menu items.

Without multiple editing tracks, you must perform basic tasks as part of cut, copy, or paste operations. On the plus side, this approach makes complex editing processes accessible to anyone with rudimentary computing skills. On the negative side, the lack of a true trimming window and markers to sync video and audio clips can result in imprecise edits.

Presto! VideoWorks can import standard file formats, but



can't import a still image or video clip directly into an existing filmstrip.

Instead of true titling functions, you must first use Image-Folio to create bitmaps of text and then add motion using VideoWorks' Magic filter. Other high-end functions are available, though. The program features nine filters to correct image quality or apply special effects, 45 transitions, six audio filters, user-defined motion paths, and transparent or chroma-keyed superimpositions.

Despite the lack of a detailed manual, these tools were easy to use, and they all offer essential configuration options. For example, you can set starting and ending values to vary the effect of a filter over time. But high-end functions don't guarantee high-quality results. With no smoothing on circular or diagonal transitions, no feathering on keyed overlays, and no subpixel positioning for motion effects, VideoWorks exhibited noticeable jaggies.

After rendering, the video plays at near-real time, and you can step through frame by frame, which is extremely convenient. Once again, however, Presto's well-designed features set suffered from a lack of rendering polish, as the cross-dissolve exhibited a pixelated, almost dithered look.

- 1 You can choose the key color and set tolerance levels
- 2 You must select the frames to be copied and pasted.

VideoWorks does not save uncompiled projects, forcing you to compile a movie each time you save it. The file-save process includes a logically presented compression screen with all relevant options. It performed well during compression tests, producing high-quality files that reasonably matched the requested data rate. Like most products in this roundup, however, Presto's Indeo video interactive file became slightly out of sync after compression.

The lack of smoothing and antialiasing functions ultimately limits the quality of videos you can produce with VideoWorks. But with tools that worked predictably and with a broad range of image-editing functions, Presto! Multimedia Suite will appeal to home users who don't already own complementary scanning and image-editing products. □

Presto! Multimedia Suite 1.5a List price: \$129. Requires: 386 or faster CPU, Windows 3.1 or Windows 95, 4MB RAM (8MB recommended), 30MB hard disk space, VGA graphics adapter, CD-ROM drive, NewSoft Inc., Fremont, CA; 800-436-4365, 510-445-8600; www.tophat.com. **Circle 412** on reader service card.

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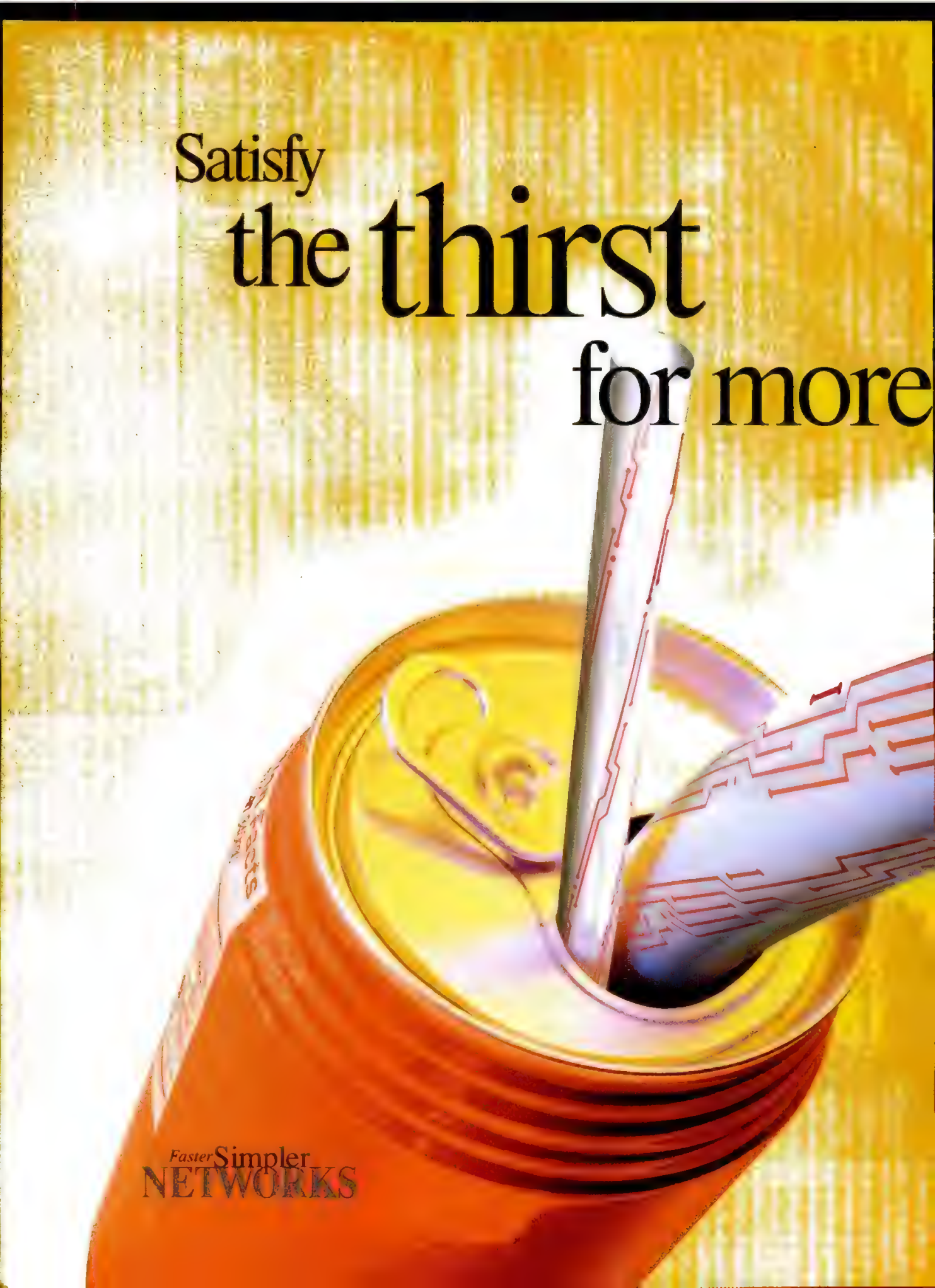
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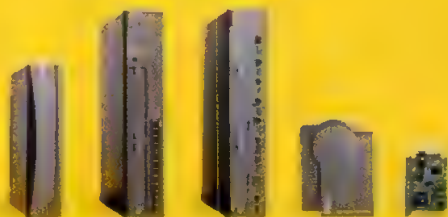


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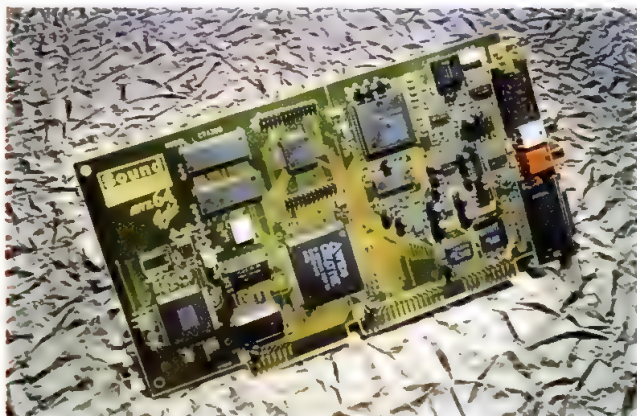


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First Looks



SOUND CARDS

Blasting for Gold

The AWE64 Gold solidifies Creative Labs' leading hold on the market—By Steve Buehler

Creative Labs, not resting on its laurels, has taken its top-of-the-line Sound Blaster audio card one step further by introducing the AWE64 Gold. While the addition of audiophile gold RCA connectors is the most visible improvement, better electronics and 4MB of memory make the AWE64 Gold a board to consider for serious PC audio.

The \$200 AWE64 Gold and its previously released sibling, the AWE64 (\$150), support 64 concurrent voices. This is achieved by using an E-mu (EMU-8000) synthesizer and the Creative Labs WaveSynth/WG synthesizer. This combination of 32 voices in hardware and 32 voices in software allows for great depth of sound in polyphonic use.

While most current games do not use more than 32 concurrent voices, the two games bundled with the card—EA Bullfrog's *Magic Carpet 2* and Accolade's *Eradicator*—give a good sense of what you'll be able to enjoy when support is available. Even if your favorite games do not use this many voices, the ability to record your own sounds, transform them using Creative Labs' SoundFont technology, and

make your own MIDI voices is intriguing.

The other breakthrough for this card is the use of a multi-point (rather than linear) interpolation algorithm. Distortion is lowered by "smoothing" the interpolated waveform between digital samples.

WHAT'S THE FREQUENCY?

In our lab testing, we checked the digital-to-analog and analog-to-digital circuits, as well as

the overall frequency response of the AWE64 Gold and the AWE64 cards. We found that while both cards were very good across the upper ranges, the Gold card had a better low-end frequency response.

The improvements between 20 Hz (the low end of human hearing) and 80 Hz are significant, with the Gold card exhibiting less than half the drop-off of the AWE64.

OPTIONS

The AWE64 Gold is bundled with the aforementioned games, one of which demonstrates the use of Creative Labs' 3-D Positional Audio feature that mimics spatial sound. Also included are the Microsoft Internet Explorer Version 3.01 browser; Progressive Networks' RealAudio player; full-duplex WebPhone software; and the mixers, wave studio, and sound processing programs that Creative Labs

bundles with all its cards.

Optional RAM modules are available to increase the AWE64 Gold's memory to a total of 32MB. These are not standard 30- or 72-pin SIMMs, however, but rather modules designed specifically for the AWE64 family.

Creative Labs has set the audio-card standard for many years, and if you are seeking true Sound Blaster compatibility, the AWE64 Gold defines the new level of sound reproduction for the mass market. It may take a while for games to catch up to the capabilities of this card, but when they do, the depth of sound is sure to impress you.

Sound Blaster AWE64 Gold. Street price: \$200. Creative Labs Inc., Milpitas, CA; 408-

428-6600, 800-998-1000; www.creaf.com. Circle 406 on reader service card.



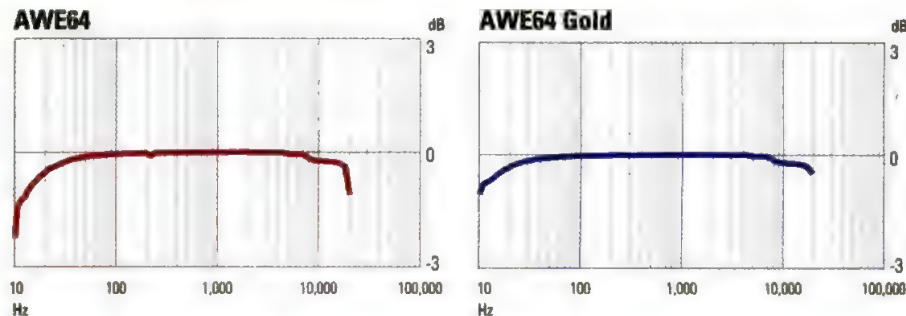
THE GOLD STANDARD: Audiophile gold RCA connectors give the Sound Blaster AWE64 Gold its name.

PERFORMANCE TESTS

Sound Cards



In our lab testing, we checked the digital-to-analog and analog-to-digital circuits and the overall frequency response of each of these sound cards. We found that while both cards were very good across the upper ranges, the Gold card had a better low-end frequency response. The improvements between 20 Hz (the low end of human hearing) and 80 Hz are significant, with the Gold card exhibiting less than half the drop-off of the AWE64.



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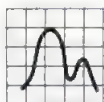
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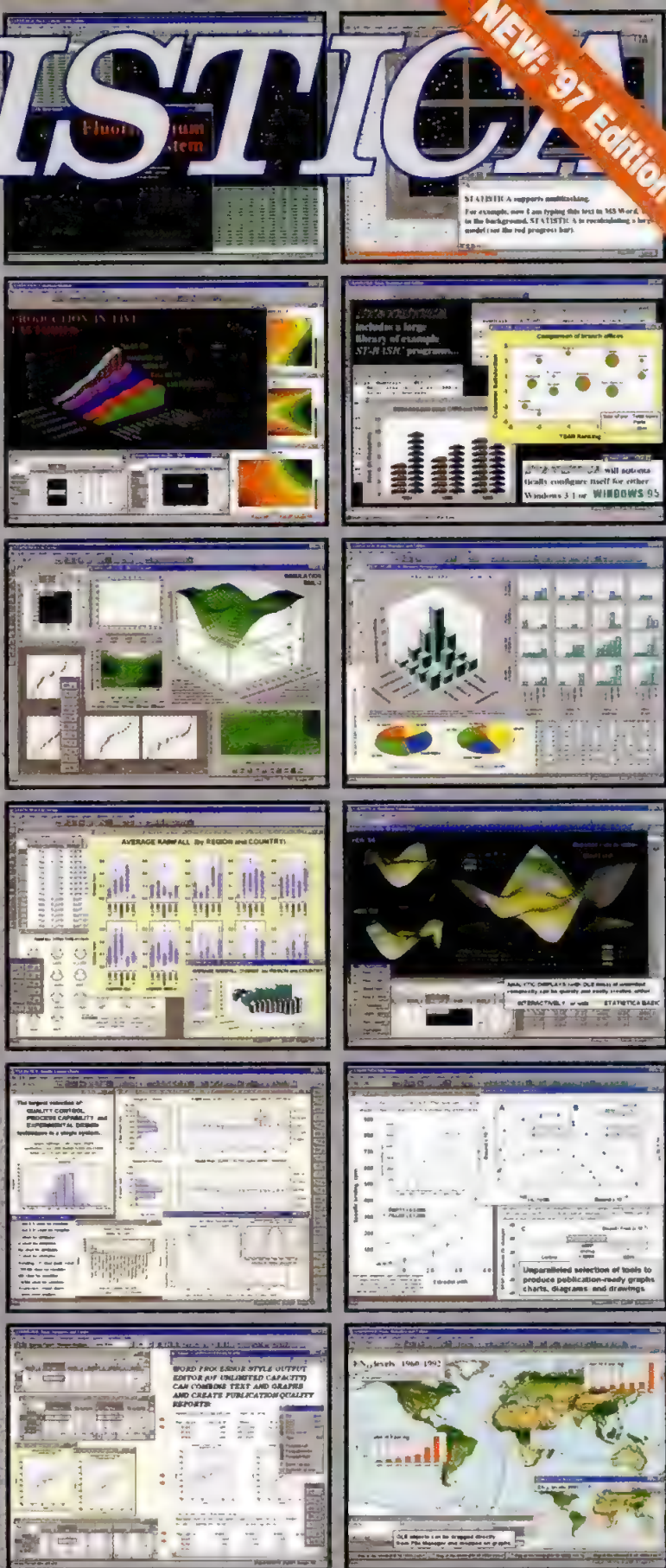
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First Looks

NOTEBOOKS

The New Subnotes

Toshiba and IBM bring out new sub-5-pound MMX Pentium notebooks.—By Carol Venezia

Believe it or not, the best in ultraportable PCs just got better. This month, notebook industry leaders IBM and Toshiba both introduced new sub-5-pound MMX Pentium notebooks: The ThinkPad 560E and the Portégé 300CT, respectively. This Portégé represents a completely new design for Toshiba, while the ThinkPad retains the case design of the original IBM ThinkPad 560.

Although these machines weigh about the same, their designs are very different. The ThinkPad takes the big and powerful approach: It runs on Intel's top-of-the-line Mobile Pentium processor (a 166-MHz device with MMX Technology) and features a full-size keyboard and a 12.1-inch SVGA display. It does not, however, come with an integrated modem.

The Portégé 300CT takes the compact and adept approach: It is powered by a 133-MHz Pentium CPU with MMX and has an integrated 33.6-Kbps voice modem, a universal serial bus port, and 32MB of RAM standard on the motherboard. But it does have a slightly shrunken keyboard and lacks integrated I/O

beyond video-out.

No matter which lightweight avenue you choose to travel, either machine is a great choice.

Toshiba America Information Systems

Portégé 300CT

When Toshiba introduced the Portégé four years ago, it quickly gained fame as the first usable



NOT IN THE CARDS: The 300CT integrates a 33.6 modem, so you don't need PC Card.

subnotebook PC. Toshiba went on to produce newer, better models that further raised the ultraportable bar.

The company's last Portégé, the 660CDT, integrated superb features, including a 10X CD-ROM drive, a Pentium/150 CPU, and an 11.3-inch SVGA display.

But at 2 inches thick with a travel weight of 6 pounds, this Portégé pushed the limits of the subnotebook category.

Enter the Portégé 300CT. This latest Portégé represents a big step back in the direction of the ultimate ultraportable for Toshiba. First and foremost, the 300CT is small: It measures just 1.5 by 10.3 by 7.5 inches (HWD) and weighs in at 4.4 pounds (including a lithium battery and AC adapter).

Second, this machine is powerful and well equipped. The Portégé 300CT runs on Intel's new 133-MHz Mobile Pentium Processor with MMX Technology. There's 32MB of system memory integrated on the motherboard (expandable to 64MB), plus 256K of pipelined-burst L2 cache. Add to this a 1.7GB hard disk and you'll be ready for some serious mobile computing.

Unlike many notebooks in this class that rely on PC Cards, the Portégé 300CT boasts an integrated 33.6-Kbps voice/data/fax modem that's cellular-ready to boot. And the fast communications features don't stop there: This ultraportable device also features two stacked Type II PC Card slots that support both Card Bus and Zoomed Video, a 4-Mbps Fast Infrared port, and a USB port.

There is one connectivity hitch with this new Portégé, however. The system unit itself houses only

a video-out port; if you want serial, parallel, keyboard/mouse, or floppy disk drive support, you must add an I/O adapter. This latter piece of hardware is, thankfully, small, weighing just 4 ounces.

The Portégé 300CT is also wired for sound. The unit features Sound Blaster Pro-compatible audio with MIDI support, plus an integrated speaker, a volume-control thumbwheel, a microphone, and a headphone/speaker jack.

Open the lid of the Portégé 300CT and you'll find out why this machine has a somewhat elongated footprint. Its active-matrix SVGA display measures about 10.5 inches on the diagonal, but it's a 1,024- by 600-pixel panel. Therefore, the display is rectangular in shape, akin to the Sharp WideNote portable.

You'll also find a slightly reduced 84-key keyboard (with key spacing of about 18 mm, smaller than the ThinkPad 560E's full-size keyboard). For a pointing device, the Portégé 300CT uses the now-familiar green AccuPoint pointing stick.

On our benchmark tests, the Portégé was a good performer; its scores weren't as high as the ThinkPad 560E, but then again the Portégé's processor isn't as fast. The machine posted a surprisingly high score on our Graphics WinMark tests—with in three points of the 560E. The only disappointment came on our BatteryMark test: The unit's time of 1:30 is very low for an ultraportable. Be aware, however,

BENCHMARK TESTS

Subnotebook PCs



The IBM ThinkPad 560E was the speed demon of this group, but since it has the fastest processor, this comes as no surprise. The Toshiba Portégé 300CT was a strong performer on our Business Graphics

WinMark tests, posting a score that almost matched the ThinkPad's. The Toshiba Libretto 50 garnered an admirable Business Disk WinMark score. Its other scores were right in line with its slower processor speed.

	ZD Business Winstone 97 Score	ZD Business Graphics WinMark 97 Score	ZD Business Disk WinMark 97 Thousands of bytes/sec	ZD CPUmark₃₂ Score	ZD BatteryMark Hours:minutes
IBM ThinkPad 560E (Pentium MMX/166)	35	50	704	325	2:09
Toshiba Libretto 50 (Pentium/75)	15	15	398	136	N/A
Toshiba Portégé 300CT (Pentium MMX/133)	29	47	482	223	1:30
N/A—Not applicable. The Libretto could not run this test.					
	BETTER ►	BETTER ►	BETTER ►	BETTER ►	BETTER ►

that this score may be attributable to the fact that our test unit was an early production model.

The 300CT will take you back to the Portégé's heyday—and you'll be glad you went.

Portégé 300CT. List price: With Pentium MMX/133, 32MB EDO DRAM, 256K external cache, 1.5GB hard disk, 10.4-inch LCD, \$3,499. Toshiba America Information Systems, Irvine, CA; 800-457-7777; www.computers.toshiba.com. Circle 407 on reader service card.

IBM Corp.

ThinkPad 560E

IBM may not have changed the award-winning design of the ThinkPad 560 with its new 560E model, but it has significantly enhanced a few key features of the product. First, the processor has been upped to a 166-MHz Mobile Pentium with MMX Technology, a significant speed boost over the previous-generation Pentium/133.

Another enhancement to the CPU subsystem comes with the addition of 256K of L2 cache. (The ThinkPad 560 had no L2 cache at all.) The vendor has also added 16MB of system memory to the motherboard, so maximum RAM capacity is now 80MB (up from 40MB).

IBM also boosted the amount of video memory integrated on the ThinkPad 560E's motherboard. This model boasts 2MB of VRAM, which is double the amount found in the previous version of the product. You can run the ThinkPad 560's 12.1-inch SVGA active-matrix display at 16- or 24-bit color depth.

The final new feature of the ThinkPad 560E is a bigger hard disk. At 2.1GB, it's significantly larger than the older 560's 1.3GB disk. While the floppy disk drive remains outboard, the spacious new hard disk should appeal strongly to storage-starved road warriors.

Fans of the original ThinkPad 560 will be happy to learn that the

case design of the new 560E has not changed. Still weighing in at just over 4 pounds with a 2,200-mAh lithium battery installed, the 560E retains a svelte form. The AC adapter and external floppy disk drive (the latter of which you'll probably leave in the office anyway) add a mere 11 ounces each. And the notebook itself—even with the speedier processor, larger disk, and added L2 cache—is still just about an inch thick.

The 560E integrates all the ports you'll need, including in-

frared serial (4-Mbps Fast IR on this model), parallel, video-out, and keyboard/mouse.

On this machine, IBM changed the cover for the rear ports to a removable rubber strip (instead of a folding plastic door), so you won't have to go through the ritual of breaking off the plastic door before it breaks off on its own.

On our tests, the 560E performed relatively well. Its BatteryMark time of 2:09 is right in

line with the original ThinkPad 560 (impressive, given its MMX CPU), and its ZD Winstone 97 score of 35 is highly competitive for a system of this type. The benefits of L2 cache were also obvious: On our ZD CPUmark32 tests, the ThinkPad's score of 325 falls right in line with other 166-MHz Pentium MMX notebooks.

If you're looking for a power-packed subnotebook that doesn't compromise, the ThinkPad 560E may be the machine for you.

ThinkPad 560E. Estimated street price: With Pentium MMX/166, 32MB RAM, 256K external L2 cache, 2.1GB hard disk, 12.1-inch active-matrix display, \$4,400. IBM Corp., Somers, NY; 800-426-2968, 914-766-1900; www.ibm.com. Circle 408 on reader service card.



THINK BIG: At 2.1GB, the 560E's hard disk is much larger than its predecessor's.

2 Pounds, Real Windows

If you're frustrated by the limitations of Microsoft Windows CE and its Pocket apps but love its ultraportability, you're just the user Toshiba has in mind for its new \$1,999 (list) Libretto 50. The Libretto has enjoyed great success in Japan and is now stateside.

The Libretto resembles an overgrown Windows CE machine, but that's where any similarities end. Packing a 75-MHz Pentium CPU, 16MB of RAM, and a 760MB hard disk, this mini-Toshiba walks, talks, and computes like its bigger Portégé brethren (albeit at a slightly more leisurely pace).

At 1.5 by 8.2 by 4.5 inches (HWD), the Libretto is a bit large for a jacket pocket. But since it weighs just 2.5 pounds (1.85 pounds for the unit, plus an AC adapter), you'll barely notice it in your briefcase.

What you will notice is the amount of paraphernalia that you have to carry if you want to connect to anything. The Libretto has no built-in ports, except for its integrated 115-Kbps infrared port; but the unit does include one built-in Type II PC-Card slot, so you can easily add a modem or other device.

If you want ports, you can add them in varying configurations. An I/O adapter weighing about a quarter of a pound provides VGA-

out, serial, and parallel connections. Meanwhile, for external keyboard and mouse support, there's a snap-on minidock that adds about a pound. The Libretto has no provision for floppy disks. Nevertheless, the machine does come preloaded with Microsoft Office 97 Professional Edition and Puma's TranXit.

The Libretto excels at squeezing a range of features into a tight space. Inside its case you'll find a 6.1-inch diagonal active-matrix screen running at 640-by-480 resolution and a compact, 80-key, 15-mm keyboard. With a bit of practice, it will be possible to touch-type on the keyboard, but you can expect to do some backspacing.

Instead of the AccuPoint pointing stick found on all Toshiba notebooks, the Libretto opts for a right-side, screen-mounted AccuPoint isometric pointer. Flat and circular, it works like a pointing stick, with actuation buttons located on the back of the screen. With this device, you can comfortably move around documents by gripping the side of the screen and rolling your thumb.

The Libretto also features Sound Blaster Pro-compatible audio with MIDI support, an integrated speaker, and a headphone jack. If you want more than CE but less than 4 pounds, the Libretto 50 may just be the ticket. —CV



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First Looks

BACKUP SOFTWARE

Backing Up Is Easy to Do

Seagate Backup Exec for Windows 95 integrates with your system's peripherals.—By Edward Mendelson

Unlike Microsoft Windows 95's backup applet, which works only with floppy disks and QIC (quarter-inch cartridge) tapes connected to a floppy disk or parallel controller, Seagate Software's \$99.95 Seagate Backup Exec for Windows 95 (formerly Seagate Backup and Arcada Backup) works with virtually all SCSI-based and other tape controllers, including DAT drives and removable media such as optical drives and Iomega's Jaz and Zip disks.

It isn't as fast as the best Windows NT backup software, and it suffers from minor glitches and inconveniences. But Backup Exec tops the narrow range of available Windows 95 backup packages.

Backup Exec offers two interfaces: a wizard that lets beginners back up and restore files by accepting or changing preset options, and a Microsoft Internet Explorer-style interface (almost identical to the main screen of Windows 95's built-in backup applet, also written by Seagate), in which custom backup jobs can be built using lists of directories and files and a well-organized set of

menus. These menus include options for password-protecting backup files and backing up the Windows Registry and NetWare 3.x data.

The wizard's default choices match the shortcuts for one-click backup and restore shortcuts that the installation program adds to your Start Menu and desktop. Reusable backup jobs created by the wizards or custom-built by a user can be run in unattended mode using either the integrated scheduler or the System Agent scheduler that comes with Microsoft Plus! The program creates an emergency-recovery disk that lets you restore an entire system without reinstalling Windows 95.

The installer detects all available backup devices on your system, and a drop-down menu lets you choose whether to back up to tape, a removable drive, or a local or network disk.

All backups are catalogued on your hard disk, and if you back up the same file more than once,

the program lets you choose between versions when you want to restore it. The catalog is convenient, but if you want to remove a backup tape's catalog that you no longer use, be prepared to wait five minutes or more while the program rebuilds it.

Backups to a removable disk (not simply to a file on a removable drive) require you to use the program to format the disk first in

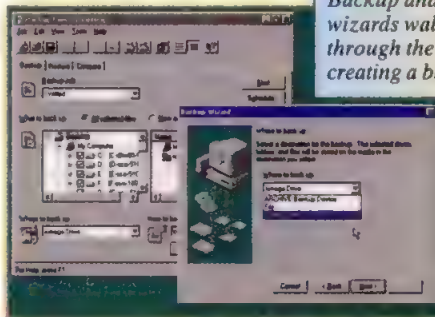
this until its next version.

Backup Exec for Windows 95 uses the same tape format as Seagate's Backup Exec for Windows NT, but it doesn't share the same interface or program code. On our tests, the Windows 95 version needed 85 minutes to back up 2GB of files, while the Windows NT version backed up the same files in 63 minutes. Seagate hopes to speed up the Windows 95 version by incorporating program code from the Windows NT version.

The major competition for Backup Exec is Chenne Backup for Windows 95, but Chenne's complex interface is too confusing for most users.

For the ultimate in trouble-free Windows 95 backups, your best option, unfortunately, is to install Windows NT 4.0 on the same machine and use either the Windows NT backup applet or Seagate's NT version of Backup Exec. But the second-best choice is Backup Exec for Windows 95. **Seagate Backup Exec for Windows 95.** List price: \$99.95. Requires: Microsoft Windows 95, 8MB RAM, 10MB hard disk space. Seagate Software, Heathrow, FL; 800-327-2232, 407-531-7500; fax, 407-531-7730; www.seagatesoftware.com. **Circle 401** on reader service card.

WE'RE OFF TO SEE . . .
Backup and Restore wizards walk you through the process of creating a backup job.

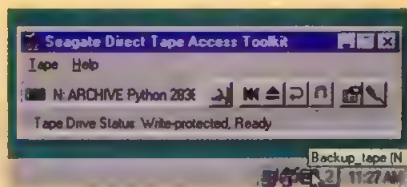


Seagate's backup format. With Iomega's Jaz, be sure to have enough Seagate-formatted disks before you begin, or else you'll encounter a major design flaw in the program. If you don't have a second formatted disk when the program fills up the first disk, a dialog box tells you to use the program's Tools menu to format the second disk—but it won't let you format the disk until you abandon the backup that you've already begun on the first disk, forcing you to restart the procedure. Seagate won't be able to fix

Direct Tape Access Gives Your Tape a Drive Letter

Seagate's \$79.95 Direct Tape Access lets you read and write files on virtually any tape drive, the same way you do with hard disks and floppy disks. This utility works with Microsoft Windows 3.x and Windows 95, and it assigns a drive letter to almost any DC-6000, QIC-80, DAT, or 8-mm tape.

You can view the contents of the tape in Windows Explorer or File Manager and access files on tape from a DOS window. You can't expect high-speed access, and some tape drives will make you wait a minute or more to load a file. But you'll be able to store and access huge files, limited only by the capacity of the storage medium. The program lets you copy files di-



DIRECT CONTROL: Direct Tape Access lets you access its control panel from a Taskbar icon.

rectly from backup tapes that use the common QIC-113 format, but it won't read individual files from DAT backup tapes. Software compression, combined with your tape drive's hardware compression, lets the program pack 4GB on a tape specified as holding 2GB.

Version 3.0 adds disk caching and a utility that creates customizable drop targets on your desktop, with options to store multiple copies of a file or to ignore user-specified file types. Removable drives such as Iomega's Jaz or SyQuest's SyJet are faster than Direct Tape Access, but tape is the cheapest of all storage media. Plus, you can store larger files on tape.—EM

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First Looks

WEB AUTHORIZING TOOLS

Feeling the Future

FutureTense Texture brings easy dynamic publishing to the Web.—By Edward Mendelson

Web publishers who want to post up-to-the-minute information on their Web sites but don't want to rebuild pages for updates should get a copy of FutureTense's \$695 (list) FutureTense Texture 1.1. This authoring tool excels at drag-and-drop creation of oft-updated Web pages (such as top stories in a newspaper's Web site).

As the price suggests, the package is designed for publishing professionals, not casual users. All its features are accessible through a simple WYSIWYG editing screen with toolbars and pop-up menus. Texture's deeper options, however, are more comprehensible if you have some Java or C programming experience.

The pages created by Texture are not traditional HTML pages. Instead, they are proprietary files that are interpreted by the Texture Java applet, which displays the pages in Java-enabled browsers. Users who want Texture pages to appear in their browsers at top speed can download a free Texture viewer plug-in for Netscape Navigator or an ActiveX control for Microsoft Internet Explorer. The viewer plug-in also allows Texture files to display with embedded fonts, which are automatically added to a Texture page when you're specifying a font name in the property sheet of a text object. Technology from Bitstream and Agfa that's built into the program compresses TrueType and Type 1 fonts for fast downloading.

An add-on utility available from FutureTense's Web site converts Texture pages into standard HTML, although the resulting pages lack Texture's native interactive features, such as boxes that change content when you click on an icon elsewhere on the page.

PAGE CREATION

To create a Texture page, you start with a blank editing screen that optionally displays a snap-to grid and movable crosshairs for precise positioning. Objects are added to the page either by dragging files from Windows Explorer or by creating them in the program itself.

When you drag graphics stored in any common graphic file format from Explorer into

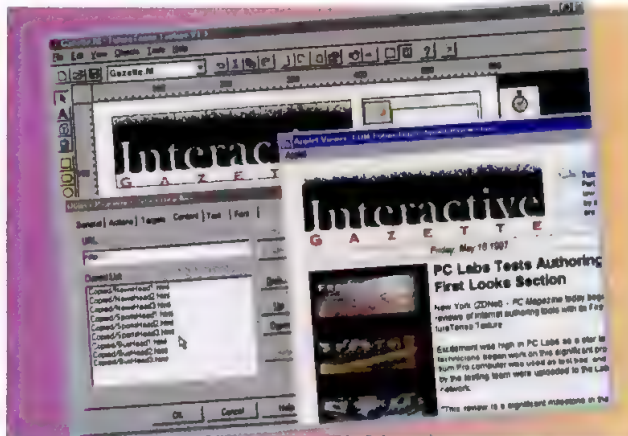
board to copy an object when one page is displayed and paste it when you display another.

With both text and graphic objects, the embedded filename—not the content of the file—is stored in the Java code, so the content can be changed simply by replacing the file. You can also create text boxes, hyperlinks, ellipses, graphic boxes, and event timers by clicking on a toolbar icon and then dragging a rectangle in the editing screen to size and position the object. Simple graphics manipulation tools let you move objects to the front and back; you can also make them transparent or opaque. A long text file can be made to flow

text object, which acts like a window on the scrolling text.

Other triggers can cause text or graphics to appear in a blank area of a page, or they can replace text or graphics that appeared previously. Texture's controls require the user to click on a trigger object, not simply move the mouse over it.

While interpreting the text file, Texture automatically strips out any HTML codes that embed graphics and any code that builds an HTML table. The content of the table—but not the borders or any other table formatting—is displayed as preformatted text. Texture has no support for HTML tables or any other HTML 3.2 enhancements. Nonetheless, you can build pages that resemble tables with borders and complex cell arrangements by superimposing text objects over graphic boxes.



COVER SHEET: FutureTense uses property sheets to specify the different files that can appear in an object.

the editing screen, Texture copies the file into the current project's folder, converts the graphic into an Internet-standard GIF or JPEG file, and displays the image. When you drop an HTML or text file in the editing window, Texture creates a resizable box that will contain the text when the page displays in the browser. The content of the text does not appear in the editing screen—you can see it only by previewing the page with a supplied Java applet viewer or in Navigator or Internet Explorer. The editing window displays only one page at a time, so you can't drag objects from one Texture project into another. Nevertheless, you can use the key-

board to copy an object and another to create the effect of multiple columns. Text objects can display the current results of queries to Internet search engines.

OBJECT MANIPULATION

All objects can be modified in a pop-up property box where you can specify the location and content of an object. There's also an "action manager" that lets you choose which other "trigger" object on the page will cause the selected object to appear, disappear, or move when the trigger object is clicked by the user. Text or graphic objects next to a text object can serve as triggers that cause a long text file to scroll up and down through a

THE LOW-DOWN

The package has only five sample template files and a few sample page elements, so you'll need design expertise if you want good-looking results. No site-management or uploading tools are included, and you will have to upload the Texture classes to your site and modify the HTML code generated by the program manually if you want users who haven't downloaded the plug-in or ActiveX control to view your pages. Compared with NetObjects Fusion, Texture excels at dynamically altered data, but it lacks direct ODBC support.

Despite minor limitations, Texture is a uniquely flexible and powerful tool for dynamic Web publishing. Organizations that post new data daily may find that it pays for itself before the first week is out.

FutureTense Texture 1.1. List price: \$695. Requires: Microsoft Windows 95 or Windows NT 4.0, 16MB RAM, 10MB hard disk space. FutureTense, Acton, MA; 800-880-7613, 508-263-5480; www.futuretense.com. Circle 405 on reader service card.



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First Looks

DIGITAL CAMERAS

The Digital Chameleon

Hitachi's MP-EG1 captures full-motion video, stills, and audio.—By Daniel Grotta and Sally Wiener Grotta

The \$2,500 (street) Hitachi MP-EG1 is the first all-digital device capable of capturing up to 20 minutes of full-motion video, 3,000 still images, 1,000 still images with 10-second audio annotations, or 4 hours of audio. It's an elegant, well-constructed, and remarkably easy-to-use camera.

Although the MP-EG1 has a few quirks, its unique features and affordability will appeal to users who shoot hundreds or even thousands of stills in a single session and to Web content creators who want the speed and convenience of direct digital MPEG-1 footage.

BRIGHT AND LIGHT

Smaller and lighter than most standard camcorders, the MP-EG1 is designed to be used one-handed. It's as easy to operate as a camcorder or an auto-everything point-and-shoot still camera. Just turn it on, select the image type, line up the subject in the viewfinder, and press Record. There's a 6X power-zoom button for framing or following the subject. Although the camera doesn't feature a true macro mode, it can capture objects as close as 11.2 inches.

The MP-EG1 has an automatic white balance that adjusts to different types of lighting. Its lens diaphragm also adjusts quickly to changing brightness levels, and the electronic shutter can capture extreme low-light situations by exposing the CCD for up to 16 seconds. The camera lacks a built-in flash, exposure-compensation capability, a backlight switch, and a provision for manually selecting f-stops or shutter speeds. All data is saved to the camera's 260MB Type III PC-Card hard disk.

Hitachi comes close to solving the problem of viewing a color LCD in bright light, thanks to three tactics: a snap-on collapsible hood that shields the LCD; an upwardly angled, 180-degree swivel lens that gives you some latitude in positioning the LCD; and the ability to adjust the brightness as well as the tint and



ALL-IN-ONE CAMERA: The Hitachi MP-EG1 excels at recording three types of media.

color of the LCD (this is the only digital camera that does all this).

PUSHING THE RIGHT BUTTONS

There are eight buttons and switches: Off/Camera/Playback, Zoom/Volume level, Recording Mode/Thumbnail, Media/Navigation, Menu (setup), Delete, Record, and a four-way diamond rocker switch for file searches and navigating through pull-down menus. The small remote control can access all controls and functions via the infrared port from up to 22 feet away, although it doesn't work in bright light and must be in a direct line of sight.

Video and audio images are recorded as MPEG-1 files at 30 frames per second, at a resolution of 352-by-240 per frame. Even with compression rates reaching 100:1, every 4 seconds of data consumes approximately 1MB of hard disk space. The camera captures still images at a 704-by-480 resolution and saves them in JPEG format. Each JPEG file occupies 40K to 65K of disk space, depending upon the image's complexity. And depending upon the mode selected, the camera can record one image every two seconds, in a burst mode of five images in 2.5 seconds or a time-lapse mode of one shot every 30 seconds, one minute, or five minutes.

Files can be organized and saved to a series of folders and may be displayed in various formats on the LCD. This makes it comparatively easy for retrieval and playback.

IMAGE TRANSFER

There are two ways to transfer images to your PC: Either swap the PC Card drive into a PC Card reader, or attach the camera to the kit's dedicated high-speed ISA serial board, which Hitachi claims offers data-transfer rates of up to 2 MBps. That's marginally faster than a Type III PC Card disk transfer.

Hitachi bundles comprehensive programs for viewing and editing video, still, and audio files. Unfortunately, they are not well integrated or bug-free. It wouldn't matter so much if Hitachi provided documentation of any sort.

GREAT VIDEO

The MP-EG1's video quality is outstanding. When viewed at a resolution of 1,024-by-768 on a



HARD CARD: Image and sound data is stored on this 260MB Type III PC Card.

17-inch monitor, playback is at 30 fps and displays in a window that's about 3-by-4.25 inches. This is more than adequate for most Web displays. Colors are accurate and vibrant, motion is clear and continuous, and audio is flawless.

Still-image quality is average, and it outputs as a continuous-tone print at sizes up to 3.5-by-5 inches without pixelizing. Nevertheless, aliasing is apparent on oblique angles, and the lack of a flash, exposure compensation, or a backlight switch often translates into subpar illumination.

The MP-EG1's zoom lens is a combination 3X optical zoom with an enhanced 2X digital boost. Although you have a seamless 6X zoom capability, going to telephoto interpolates the images, thus reducing picture quality.

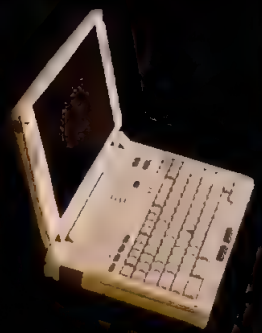
What we liked most about the Hitachi MP-EG1 is that it's really fun to use. You can effortlessly mix and match video with stills and audio, get instant-replay feedback, and transfer images to your PC in standard file formats. And you don't need an engineering degree to do it, either.

MP-EG1: Street price: \$2,500. Requires: 100-MHz Pentium or better, 16MB of RAM (32MB recommended), Microsoft Windows 95, 80MB of hard disk space, 4X CD-ROM drive, empty ISA slot or PC Card drive, speaker and Sound Blaster-compatible audio card. Hitachi Home Electronics (America) Inc. Norcross, GA, 30093; 800-448-2244, 770-279-5600; www.mpegcam.net. Circle 404 on reader service card.

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First Looks

REMOTE MAPPING

GPS Maps Aid Navigation

Compass and Etak SkyMap personal navigation systems extend PC/car convergence. —By Bruce Brown

If you want in-car navigation without having to pay thousands of dollars for an in-dash system from a car manufacturer, check out Chicago Map Corp.'s \$229 Compass and Etak's \$299.95 SkyMap (list prices). Both bundle mapping software with fast-signal-acquiring 12-channel GPS units.

With these packages, you can track your current location via civilian signals from Department of Defense satellites. The mapping software in both can run without the GPS, but the packages' greatest value is evidenced when the software and hardware work together.

Both tested packages are good for planning trips, determining current direction and speed, and finding your current location. With Compass or Etak SkyMap, you should never get lost and, better yet, never have to ask for directions.

Both packages include safety caveats that are worth mentioning here. It's not safe for a driver to use a computer while a vehicle is in motion. You can keep the system running to track your progress and location and to record your trip, but if you need to operate the software, pull to the side of the road.

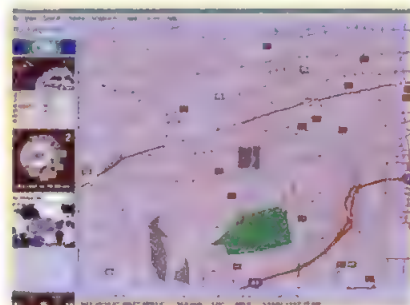
COMPASS

Chicago Map's Compass includes a Lowrance Electronics Eagle Explorer handheld GPS, Precision Mapping Streets 3.0, and Compass GPS software. Unlike Etak's packaged GPS unit, the Eagle Explorer has its own LCD screen and can be used without the computer for all means of transportation—even walking.

The map data covers the entire U.S. on a street level. Precision Mapping Streets doesn't automatically plan routes, but you

can use the system to select a destination and up to 750 additional stops on the way. If you don't have a CD-ROM drive, you can isolate individual-state data to store on your PC's hard disk.

The 12-ounce GPS measures 1.6 by 2.2 by 6.5 inches (HWD) and plugs into the computer serial port with a six-foot cable. As of June 1, the data cable also provides power to the GPS, which previously ran on four AA-size batteries. The GPS uses an internal antenna to track satellites and must be placed near the windshield. Because the data cable plugs into the bottom of the unit, you'll need a bracket or velcro to keep the unit upright.



MY KINDA GPS: Chicago Map's Compass traces your path on the screen and displays GPS data.

The Compass package quickly acquires an accurate signal and plots points on the screen as you move, indicating direction with an arrow. The map can be set to shift with your direction or to keep north up constantly. Features include one-key zooming, a trip recorder, and location searching via telephone area code and exchange, zip code, and city or place names.

While the program is running, you can view the GPS location, direction, and speed data in addition to the map. On the whole, the Compass is a powerful com-

bination of nationwide street maps and a multipurpose GPS at an aggressive price.

Compass. List price: \$229. Requires: 486 PC or better, 8MB RAM, 6MB hard disk space, serial port, CD-ROM drive, Microsoft Windows 3.1 or later. Chicago Map Corp., Lemont, IL; 800-257-9244, 630-257-7616; fax, 630-257-9678; www.chicagomap.com. Circle 402 on reader service card.

ETAK SKYMAP

The Etak SkyMap bundle includes digital maps of the continental U.S., including street addresses, restaurants, lodging, services, and points of interest for 37 major metropolitan areas. A PC Card Type II GPS with a remote wired antenna sits on the dashboard.

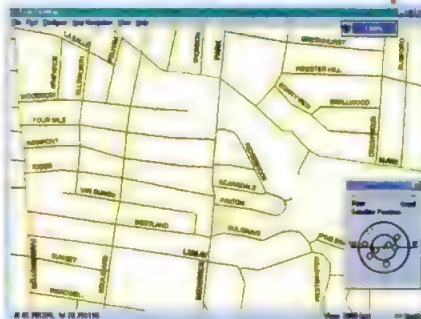
An infrared remote control lets you run the program without touching the PC's keyboard or pointing device.

The Etak antenna and PC Card clip together when not in use and (with the remote control) fit inside a vinyl storage case included with the package. A suction cup on the antenna cable and included velcro strips can secure both the antenna and remote control storage bracket. Because the PC Card draws power from your computer, your battery will drain faster with the GPS running (unless you have a 12-volt power inverter in your car). This GPS does not have a screen and will not work independently.

After software installation and GPS initialization, the program tracks your movement automatically by marking your current position on the screen with a teardrop-shaped icon. SkyMap won't leave position tracks and doesn't include a trip-recording function, but you can

save personal marks on maps for later study or reference.

The program calculates routes using overview maps, not area detail maps. Location searches by address or points of interest use information from the detailed map data. As with Compass, SkyMap lets you set



SKY'S THE LIMIT: Etak SkyMap marks the current position with a teardrop icon and shows satellite signal strength, although it fails to display speed and direction.

the maps to hold north up or face your current direction.

On testing with the GPS installed, the SkyMap package worked fine, except for one bug that may have been specific to the Micron Transport test computer. Whenever the View Meter Panel (a pop-up window that displays GPS information) menu selection was clicked, the program hung and the system had to be rebooted. Without the Meter Panel display, some of the data is missing. Etak engineers are currently working on a solution to this problem.

The remote control was a joy to use, with a menu key that navigates the program's menu hierarchy and zoom keys. All in all, Etak's bundle is an attractive package for those who don't mind spending a bit more for ease of use.

Etak SkyMap. List price: \$299.95. Requires: 75-MHz 486 PC or better, 8MB RAM, 20MB hard disk space, PCMCIA Type II slot, 2X CD-ROM drive, Microsoft Windows 95. Etak Inc., Menlo Park, CA; 800-765-0555, 888-275-9627; www.etak.com. Circle 403 on reader service card.

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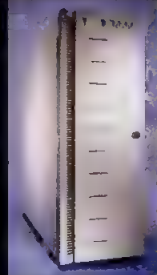
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- 8 Hot-swappable Drive Bays
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Second Looks

WEB DIAGNOSTICS

Navigating Made Easy

When we looked at Starfish Software's Internet Utilities 97 (First Looks, April 22, 1997), we praised its unified approach to incorporating a variety of useful Web applications. Our favorite was the nice graphical implementation of the Ping command—TraceRoute—which shows a map of the trip your data packets take between your PC and its eventual destination.

Net.Medic 1.0, from VitalSigns Software (see review, below), takes this concept a step further with a group of utilities that shows you where the bottlenecks or slowdowns lie and tells you what you can do to remedy your problems. This isn't to say that Internet Utilities 97's usefulness is in any way diminished. IU97 is still a strong, feature-filled program that acts as a lifeline between your PC and your

Internet connection. IU97—which can be downloaded for a free 25-day trial version—puts together 25 of the handiest Internet utilities around. The utilities appear on a noninvasive toolbar that can be put anywhere on your desktop. Unfortunately, once you decide where you'd like it located, that's where it will stay.

The interface also integrates Microsoft Windows 95 program functionality, so you can switch between your applications and documents without using the Start Menu. The program knows exactly how to separate them, putting each one into a correctly named folder.



NAVIGATING

One of the most notable features remains QuickMarks, a simple way for you to move between your Microsoft Internet Explorer Favorites and Netscape Navigator Bookmarks lists. The program imports both lists and lets you access sites as icons, an improvement over the boring pull-down menus in Navigator and Explorer.

Adding a site to any of the lists and managing existing lists is as easy as clicking a small, red check mark. Another big plus is QuickMark's ability to monitor often-used sites for updates, so you'll never have to visit a stale site again.

ZIP IT UP

If you download files often, you'll appreciate QuickZip, a file compression and decompression program. Using the program, you'll be able to zip and unzip your files and quickly create self-extracting files (.EXE). Icons for the utility are conveniently located below your QuickMarks list.

Rounding out the utilities is a collection of InternetTools that includes an FTP program, a Usenet news reader, Finger and Whois utilities, a timing utility, and the aforementioned Ping program. If you're a true FTP power user, however, you may want to look elsewhere for an FTP program.

You can probably gather many free programs that will do for you what Starfish Software's Internet Utilities 97 does for \$30. But you'll be hard pressed to find such convenience, ease of use, and functionality. IU97 is one of the best Internet productivity suites around.

WEB DIAGNOSTICS

Net Connections

Everyone experiences Internet delays once in a while, but getting to the root of the problem is often difficult. It could be your system, your modem, your ISP, or a router half the world away. Now, VitalSigns Software has created Net.Medic, Version 1.0, a browser companion that will help you diagnose and solve problems with your Internet connection.

Net.Medic launches when you start your PC. It features several connectivity boxes (which resemble your car's speedometer) and a scrolling marquee that gives you up-to-the-minute reports on what your programs are doing, which pages you're accessing, and any error messages you receive.

Net.Medic gives you real-time data about your throughput, page- and file-retrieval times, Web server load and efficiency, network congestion levels, and modem and system resources. You can view the info as a stand-alone application or as a pane on your browser.

FIX IT ON THE FLY

Net.Medic offers suggestions and fixes connection problems on the fly. For example, if you request a page and the server is unresponsive, Net.Medic resends the request. If you want to see what problems it has discovered over a period of time, you can check out the Health Log, which lists trouble spots plus the steps you can

take to remedy them.

The program can keep tabs on resources via ten windows (Activity, Throughput, Retrieval, Client, Modem, Intranet, ISP, Internet, Server, and Connect Time), and you can view all or several of them at a time. If Net.Medic senses a problem in any of these areas, the program will change the pane icons' colors from gray (for healthy status) to yellow or, even worse, to red (for unhealthy status).

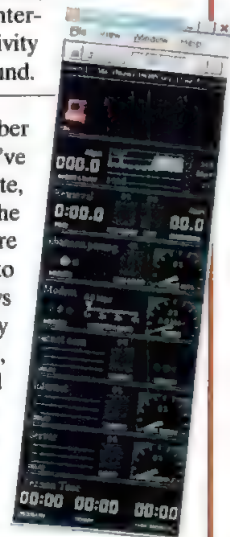
The Client pane gives you the lowdown on your CPU, including its health, and tells you how many times your browser accesses your cache. The ISP pane informs you how much of your Internet delay is caused by your provider, so you'll know if you should complain or even switch ISPs.

The tickerbar gives you instant updates on such topics as the name of the Web site you're visit-

ing, the number of times you've visited that site, the size of the page you're attempting to receive, delays caused by the network, and unread e-mail messages that meet specified criteria.

Net.Medic, Version 1.0 List price: Free for 30-day trial version, \$39.95 if you decide to keep it. Requires: Microsoft Windows 95 or Windows NT 4.0. VitalSigns Software, Santa Clara, CA. www.vitalsigns.com.

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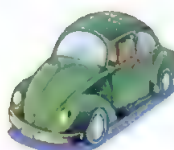
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DirectX: The Party Pooper

Don't ask my wife about DirectX. She has no idea what it is, but she hates it. With a passion. Don't ask my son about DirectX. You'll get a litany of complaints about drivers, certification, and interactions, delivered with all the moral outrage a 12-year-old

can muster. And my daughter has no opinion on the matter. As long as she can chat with her friends online, she's happy.

It all started with Andrew's impending birthday. He's mad for video games, and the choice was to get several games for the PC or a Nintendo 64. We discussed the issue with him, and after careful consideration, he decided that he'd get more mileage and enjoyment from the PC route—given the opportunity to play multiplayer games over the Internet, the deeper play of the PC games, and the profusion of titles. As much as he'd love to play 3D Mario, the attraction of Rebel Assault II, X-Wing vs. TIE Fighter, and Magic: The Gathering was just too great.

Our latest computer promised to be a dynamite gaming machine: a 233-MHz AMD K6 with 64MB of RAM, a Matrox Millennium, a 4GB SCSI hard disk, a Sound Blaster 64, and a 12X CD-ROM. I'd already decided to upgrade the sub-\$25 joystick to a Microsoft Sidewinder 3D Pro. We were looking forward to the greater stability afforded by the 3D Pro's digital technology, not to mention the cool twisting, rudder, and strafing maneuvers. (I'm not much of a gamer, so I take Andrew's word for all this.)

Joystick installation went smoothly, so we moved on to the stack of games. The 3D Pro came with a game called Hellbender, which Andrew says is just like Terminal Velocity, except where it's different. We installed Rebel Assault II first, which then installed the DirectX drivers. DirectX, in case you're as game-impaired as I am, is Microsoft's application programming interface for gamers. It creates a thin, fast, consistent layer over the hardware, so programmers need write only to DirectX instead of supporting all the hardware configurations possible in a PC.

DirectX also solves a major problem for the programmers: the slowness and general unsuitability of the standard Windows APIs for gaming. It also ensures that Microsoft maintains control over the APIs. (Microsoft hates it when anybody else creates an API for Windows.) Programmers were going around Windows entirely, creating their own internal APIs for their games.

I won't go into the sorry history of DirectX or recount how many fourth-quarter seasons were missed as game developers labored with drivers that shipped late, broken, or not at all. Today we're up to Version 3.0, and Microsoft is running true to form in that this is the first generally satisfactory version.

Anyhow, back to the install. Rebel Assault II worked fine. X-Wing vs. TIE Fighter froze a short way into the program. Magic: The Gathering died messily, after insisting that we reduce the screen resolution to 640-by-480 and 256 colors. Hellbender worked okay, but then the joystick started losing its calibration. We reinstalled it a couple of times. But even when we shut Win 95 down properly and restarted the machine, it said we hadn't, and performed a scandisk before rebooting. And we rebooted a lot. We uninstalled everything but Rebel Assault, hoping to get back to a workable system—to no avail.

Twelve-year-olds can be tough, but mine was close to tears. He was disheartened and stomped off to his room to read a nice, dependable book, which doesn't need an operating system. Sharon was fuming, ready to take everything back to the store and trade it in for a Nintendo 64.

I figured that the best way to restore peace was to dig into the system and figure out what was wrong. I soon determined that of the eight or so registered DirectX drivers, one of the audio drivers

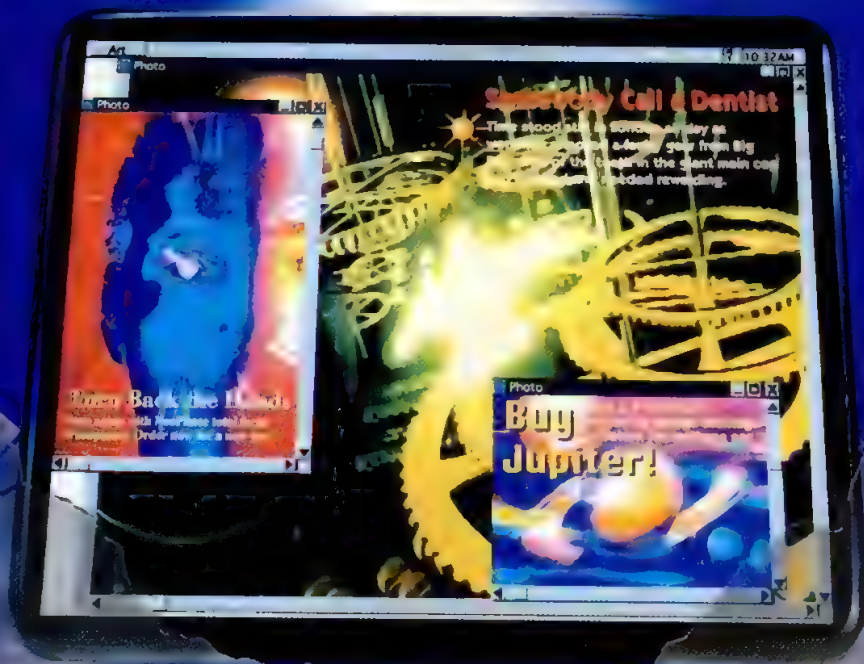
was not certified. I knew that Creative Labs, the makers of the Sound Blaster, had been tardy in getting the latest drivers out, so I went to the company's Web site and installed a new driver that had been posted just three days before.

Andrew started reinstalling everything, breathing a big sigh of relief each time we passed a previous crash point. Everything worked, with the only residual weirdness being that when you play Hellbender after having played X-Wing vs. TIE Fighter, it plays the *Star Wars* background music instead of its own. Win 95 still thinks that it's been crashed from time to time, and some of my MIDI programs are acting strangely, but we're making progress. □

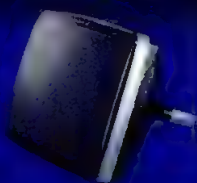


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File Not Found

Right now the World Wide Web has somewhere between 150 and 200 million pages online. Maybe more. We're approaching a million domain names, and there's a sense that things are getting out of control. The worst part is that people are throwing

pages up with little regard for the plight of the users. Pages are seldom updated, and corrections are rarely made. The nature of the Web allows for a certain lack of responsibility on the part of all Web publishers. It's not as though anyone has been killed by a dead link, so why be concerned?

Well, at a time when I needed to find out something about my frequent-flyer account, the United Airlines site seemed to be down completely. No messages, nothing. Just off the Web. How this could happen is beyond me, but the ticketing computers go down all the time too, so why shouldn't I be surprised? Even TV networks have backup plans when a tape machine malfunctions during a broadcast: Another unit is playing simultaneously. Important Web sites should consider real-time backup systems.

Anyway, if this can happen to United, why should we be shocked that half the links on a page are dead? I come across missing links every time I'm on the Web. And I guarantee that you can't go from link to link to link without uncovering link entropy—the slow deterioration of the link structure on the Web as a whole.

Here's a game you can play: How many sites can you link to and from before getting a 404 (file not found) error or worse? Ten maybe—if you're lucky. I foresee a Guinness world record for someone who can link from site to site to site successfully without a failed link. "Hank Smithers linked to 400 sites before encountering a 404 error."

Remember, the Web is all about links. It's called the Web because it was designed to be a "Web" of hyperlinks. We have to show some sense of responsibility regarding these connections, since dead links are a source of frustration.

When I go looking around my own Web pages I find dead links all over the place. I could eradicate these links, and I do scratch many of them; but there are numerous problems in doing so, and I see no way of correcting them.

Removing dead links isn't always the answer, and here are some reasons why:

- The dead link may be temporary, as with the United site. Do I have to remove my link and keep checking back until

the United site is back up to return it to the list of links? No one is going to perform this exercise in futility.

- The site may be part-time. There are thousands of sites that simply are not up all the time. Countless college kids, for example, have sites running on a dorm network that

can be up and down all day. While these sites are a joke in some ways, they are, in fact, on the Web and linkable—sometimes. The only advice I have here is to uncover this temporary aspect and annotate your list of links with this information.

- The site may be part of a flaky overseas network. There are more than a few sites in Japan to which I've tried to link, and these sites are routinely dead for no apparent reason.

- The site may have moved and may have a new name and DNS routing. This situation will eventually be corrected by site publishers who realize that owning a domain name—just one name will do—is the best way to avoid this problem. There is really no excuse for elaborate Web sites stemming from a URL that is a yard long and situated within another domain, nested in subdirectories ten deep. Pay the hundred bucks and buy *Icannottakeitanyomore.com* or whatever. While all the single-word domain names are used up, you'd be surprised what's available if you put two words together.

My advice to Web publishers is to check links weekly. If the link stays dead for two weeks, find out where it moved or

remove it from the list of links. At least annotate the link with some information that indicates you are on top of this situation. You must have a policy of some sort in place. I've been to too many sites where the dead links have been left on the site for months with no annotation. There is no excuse for this. Unless you're a busy columnist, that is. Start with www.dvorak.org and see how many dead links you can find.

I would advise users to complain bitterly about dead links. I can assure you that reading such e-mail is more time-consuming than fixing the problem. Most Web publishers will do something once a few complaints are lodged. Let's stop link entropy now! □



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I find missing
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Inside Track

recall that about a decade ago all the makers of semiconductors talked about the **1-micron barrier** as if it were the sound barrier in 1940. Now we're moving toward the 0.25-micron process. Both AMD and Intel expect their **300-MHz microprocessors**, which now use the 0.35-micron process, to use the 0.25-micron process probably before the end of the year. When AMD rolled out its K6, it had a bunch of 0.25-micron chips ready to show. I suspect Intel is eager to do anything to reduce chip size.

These developments do not take place in a vacuum or overnight. **Years of research and development** go into each change. Currently all the research is divided into **two main camps**, those developing the 193-nanometer ultraviolet laser to be used for the 0.18-micron process, and the newer X-ray lithography (XRL) crowd. The latter group knows that the future is in XRL but also that the industry is going to be reluctant to move to it quickly, since it will require a complete redesign of almost everything and since, the XRL group believes, the changeover will be much more expensive than continuing to shrink spectrum light technologies. The problem with shrinking the old technology is that it seems to be at a **dead end** at 0.18 or maybe 0.15 microns. Worse, it's possible that even 0.18 microns may not be achievable. There is no lens material that can withstand the **million-burster-minute** laser pulse without being damaged. The XRL crowd will be pleased if these failures continue, because they may quicken the decision to move to XRL (which begins its process life at 0.13 microns).

Curiously, Intel is funding another research effort called **Extreme Ultraviolet lithography (EUV)**, the goal of which is to achieve 0.13 microns without using X-rays. The key here is a 13-nm beam that requires even more special optics. Insiders believe that if a 13-nm EUV system is developed, then all bets are off.

If XRL happens **sooner rather than later** (assuming all the efforts to stay within spectrum light are failures), I believe we'll see a momentary industry slowdown as production snafus and price hikes confuse the market. This should come to a head in the next 12 months.

I found all this research interesting in light of a recent survey in *R&D Magazine* that revealed that more than 80 percent of respondents think **America will lose its competitive industry edge** within 25 years unless basic-research funding is increased.

While on the Subject of Surveys Dept.: According to IDC, the amount spent on Internet and intranet products and services was \$19 billion in 1996 and by 2000 will reach an **astronomical \$92 billion!** Supposedly

Looking for other ways to waste your time using computer technology? How about the world's biggest online chat system—the Internet Relay Chat? At any given time there are 100,000 users chatting on IRC. This is a serious time killer.

this is a conservative number, as it reflects only end-user spending. The entire IT marketplace, by the way, is \$610 billion.

Taiwanese Notebook Dept.:

As the ultimate notebook computer seems to have found its niche in machines such as the IBM ThinkPad 560, you have to wonder what designers will do to differentiate their machines. We can be sure that a 21-inch screen won't be something we'll see on any practical notebook. How about a feature such as an **SVGA output port**? That's coming soon from Taiwanese designers. Unusual idea! And consider this: A lot of money is out there for someone to design a **slim CD-ROM mechanism** for these machines. Can you imagine the ThinkPad 560 with no visible design change yet having a

CD-ROM slot? That's the challenge.

Collecting History Dept.: Remember Tony Cole, the first (and I believe the only) private citizen to **procure a Cray-1**? I first told you about his collectibles two years ago. Now he's managed to secure one of the **last Cray-2s**, which he's turning into a historical artifact just as he did with the Cray-1. For \$149, you can buy logic or memory cards encased in beautiful Lucite shells, engraved with the card number and description. I suspect these stunning collectibles will be the only Cray-2 pieces ever on the market, as the machines are usually **melted down** for the gold or simply destroyed. Cole has a Web site showing these pieces—along with what's left of a Cray-1 and various other oddities—for the person who has everything. Check out his Web site at www.memorybilia.com for a complete listing, including pieces of a Cray-3 that was never completed.

Summertime Fun Dept.: Are you looking for more ways to waste your time using computer technology? Look no further than the **world's biggest** online chat system—the Internet Relay Chat, or IRC. Over the years this has been the realm of Unix hacks, but recently some tremendous software has been developed in Europe to make it easy. It's called mIRC and is coded by Khaled Mardam-Bey for Windows 3.x and Windows 95. This system has developed into one of the **finest pieces of code** available and is downloadable as shareware. With any Internet connection you simply boot this code and you're immediately on IRC, no matter what page you are viewing. The links are built into mIRC for you; you click and go.

The IRC is divided into competitive international networks. The best networks for chatting are DALnet, EFnet (considered the original IRC system), and Undernet. **Most support personnel** for most companies are on this thing 24 hours a day, and it's a great way to get questions answered fast. Download the software at www.mirc.co.uk—highly recommended. □

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PIMming Around in the Outlook Era

When Microsoft shipped Office 97 at the end of 1996, it slipped the rest of the PC software industry a Mickey. It wasn't just that Office 97's individual apps were somewhat too greatly improved over their Office 95 counterparts—though they were.

And it wasn't just that Microsoft continued the aggressive pricing of application suites it had been following since it created the suite business six years ago—though, certainly, the under-\$200 street price of the standard edition of Office 97 pinches the competition.

The unexpected twist was the inclusion of Outlook in the box.

Microsoft hadn't been a player in the personal information-manager market before, and few users—accustomed to thinking of Microsoft as a vendor of operating systems and ponderous productivity applications—expected a PIM from Redmond. Microsoft began warming up industry press and analysts for the arrival of Outlook in mid-1996, and by fall the Redmondians were saying they thought Outlook was going to be the big surprise, the unexpected hit in Office 97.

One hears that sort of thing from Microsoft PR people often enough—there have been any number of Second Coming products from Microsoft over the past decade, according to the flacks—and discounts it. But prerelease teaser copies of Outlook did look pretty interesting, and the promise of a highly integrated PIM that could not only tie together appointments and contacts but also manage your e-mail and draw on links to Access databases sounded great. Outlook got a lot of press attention when Office 97 finally did ship after Christmas, and most of that coverage was favorable.

What few of us thought about much, though, was the effect of Outlook's being free in the box with every copy of Office 97 on the PIM marketplace. Six months later, Outlook has transformed the PIM business, with unhappy consequences for the producers of every other PIM—and often for their users as well.

The PIM marketplace has been a fragmented business ever since early copies of would-be PIMs such as Sidekick pretty much invented the market more than a decade ago. Some of the best and best-loved PIMs come from relatively obscure sources: OnTime, for example, from Campbell Services in Michigan, and Okna DeskTop Set from Okna Corp. in New Jersey. But not all: Lotus Orga-

nizer comes in every SmartSuite 97 box, and NetManage's ECCO Pro 4.0 has wide distribution. Shareware hits such as Time and Chaos and ChronoLogic are the tip of a huge iceberg. You can search the ZDNet shareware library or any other shareware source and you'll find hundreds of wildly different PIMs.

We also demonstrate amazing bonds to PIMs we've come to rely on. I have friends using the most amazingly obscure, clumsy, and obsolete PIMs. But when I show them something new and a *lot* better, I get nods and hmm and that's about all. I understand that, as much as I find it funny, inertia is a huge force in the software market. And to avoid embarrassment, we usually dress it up in folk wisdom such as "If it ain't broke, don't fix it." Most of us would do nearly anything to avoid learning a new word processor or spreadsheet—or PIM.

I succumb to that, too. I use and rely on ECCO Pro, admittedly one of the most complex products on the market. You can do nearly anything with ECCO, but I don't do much beyond keeping my schedule in it. (I use HotLine for Windows for my phone book, and parts of Outlook for e-mail and some scheduling). ECCO is a superb calendar/appointment-book creator, and I'm entirely satisfied with its value in that one role. (When I say this in print, dedicated ECCO users around the world send me letters explaining how much happier I'd be if only I used more of the program, and they enclose stacks of disks with

their unbelievably complicated and often quite elegant ECCO mini-apps. Please, friends, not this time! As I said, I'm perfectly happy with what I get from ECCO now.)

PIMs are like that: Erector sets that allow us to create whatever we want—and then encourage us to persuade the rest of the world that's what *they* want, too. Now, this goofy, chaotic world is being turned upside down by Outlook.

Free is a very hard price to compete with. Up against the Microsoft Outlook free-in-every-box, decoder-ring-style pricing (and Lotus Organizer's similar presence in every copy of SmartSuite 97), practically any price looks expensive. To be sure, some very good PIMs still have prices from



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about the effect
Outlook would
have on the
rest of the PIM
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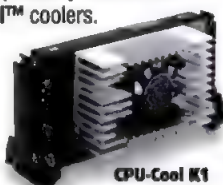


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JIM SEYMOUR

another era: Okna still charges \$295 per copy of DeskTop Set 6.0, with a five-user license costing a whopping \$995. But even a \$69 to \$79 commercial product, or a \$25 to \$35 registration fee for a shareware PIM, looks pricey against the Outlook price: \$0.

We are now in what a friend in marketing calls "The Outlook Era." Outlook has permanently changed the dynamics of the PIM marketplace, with the result that many other commercial PIMs will someday disappear from the market, or at least stagnate without updates, as their developers cease work on upgrades and milk them for whatever revenues they can produce in their present state.

Not that every other PIM will disappear, of course; that fanatical customer loyalty will keep the installed bases of many PIMs above water for some time to come. But if we're not buying upgrades for those other PIMs—either because those upgrades are simply unavailable or because we are unwilling to spend good money to upgrade products for which an excellent free alternative is to be found—then we're not keeping those products' developers alive. The installed base of 1-2-3, Release 1a, remained huge long after Lotus had moved way beyond that early release, but those users weren't contributing a nickel to Lotus's revenues for years.

It would help, a PIM developer said the other day in what must have been a painful joke, if Outlook were *bad*. Fortunately for you, me, and Microsoft (but unfortunately for PIM developers), Outlook is very, very good. In some ways, it's a stalking-horse for other Microsoft products. To get the most out of it, run your company on Exchange Server; but on its own, it's plenty useful.

Microsoft also twists the knife for its PIM competitors—and helps you and me and many others among the 15 million out of 60 million Office users who have upgraded to Office 97—with a huge library of online resources for Outlook users. Take a look at www.microsoft.com/support/products/office/outlook/content/download.htm for details; and especially check out the Beyond Help pages, updated daily, at www.microsoft.com/office/freestuff/officehelpextras/. There you'll also find an amazing list of add-ons and other free extensions to Outlook.

When the elephant dances, lots of good folks get stomped. If you rely on another PIM and haven't updated it for a couple of years, think about buying that upgrade now—or take a look at Outlook. □

My Perfect PC

Elsewhere in this issue, you'll read the collective judgment of *PC Magazine's* 100 editors and labs staffers on what constitutes the perfect PC, perfect notebook, perfect components, and perfect connections. Here, I want to offer a personal view, high-

light key issues you'll face buying PCs in the second half of 1997, and add some thoughts on the market at midyear.

First, there's the best-ever variety of CPUs—by my count, ten that are worthwhile—times two, three, or four clock speeds. Pentium II is the most intriguing chip from Intel. It acts like a Pentium Pro, but with MMX instructions added. It's equally content running Windows NT and Windows 95, and it has the highest clock speeds of any Intel CPU, up to 300 MHz. Also, this fall, a better chip set is due (what we expect will be called the LX chip set)—adding Advanced Graphics Port (AGP) and Universal Serial Bus (USB) support. Most of the top-tier vendors are privately telling their best customers that it's this second iteration of Pentium II that makes sense. I agree.

If not Pentium II, then Pentium MMX. There are lots of reasons for home buyers to get these multimedia-enhanced CPUs, and a lot of *promises* about why business buyers should get MMX. In business, it boils down to this: There's not a lot you can do with MMX today, but there will be over a two- to three-year period. Besides, MMX versions add only fractionally to the system cost. I'd pass on the original Pentium and (except for servers) the Pentium Pro. Keep AMD's K6 in mind; PC Labs finds it roughly on a par with Pentium II CPUs. The Cyrix M2 should also match the Pentium MMX and possibly the Pentium II.

I recommend the highest CPU speed—although it carries a stiff price premium—or the second highest. Better to go with the second and spend the difference on more memory or a bigger hard disk.

Don't be cheap with memory. Get 32MB *minimum* for Windows 95, 64MB for Windows NT. Don't be afraid to double it. If that sounds like a lot, just tell yourself that you're only spending \$200 (\$400 for Windows NT) on system memory. Besides, what's a *lot* of memory? Digital extolls the virtue of Alpha PCs configured with 4GB of main memory, noting that it really speeds up some complex operations, and it's relatively "cheap" at less than \$16,000 for the RAM.

Get 4MB of graphics memory, which translates into

true color at 1,024-by-768 resolution—the highest you're likely to use. (By the way, if you hear the term K7, it's not the next AMD chip. It's emerging shorthand for 1,024-by-768. Some vendors still don't like using XGA—Extended Graphics Array—because of its origin as an IBM term for interlaced 1,024-by-768.)

You won't regret spending extra money on a bigger hard disk or more system memory. One of your goals should be never having to open your system over its life, though the one exception to the sealed-case rule may be upgrading your modem. As you know, there are two competing standards—U.S. Robotics' x2 and Lucent/Rockwell's K56flex—and nobody really knows who's going to win. Pick a 56-Kbps modem, knowing it's compatible at 33.6 Kbps now and hoping it's upgradable later.

Unless you're cost-constrained, set aside \$500 to \$750 of your money for enhancements: a 17-inch monitor (a \$300 upgrade), an uninterruptible power supply (\$100 to \$150), a better mouse (\$50), a grippy 3M mouse pad (\$10), maybe a better keyboard (\$75), and perhaps a removable disk (Iomega Zip or Jaz, \$150 to \$300). So while you can buy a decent PC for less than \$2,000, you'll be a lot happier with what you get for about \$3,000. If you're cost-constrained, in addition to looking at \$1,000 PCs, such as the Compaq Presario 2100 series, check out "buyer's remorse" PCs. These are new PCs that buyers returned for what-

ever reason. They work fine, are discounted 10 to 25 percent, and have full warranties. Direct vendors sell refurbished PCs on site; some sell over the phone.

What if you wait to buy? If you hold off until year's end or early 1998, you'll get a more mature chip set for Pentium II and support for AGP. On all PCs, I hope you'll finally have USB functioning mechanically, supported by the operating system, and maybe even have some devices that use USB. If you want the Windows 97 operating system (Memphis) preinstalled, that's (again, hopefully) going to be sometime in early 1998. And you won't see a version of Windows NT that supports Plug and Play until 1998. □



SUGGESTION BOX

Go with the second-best CPU speed and spend more on extra memory or a bigger hard disk.

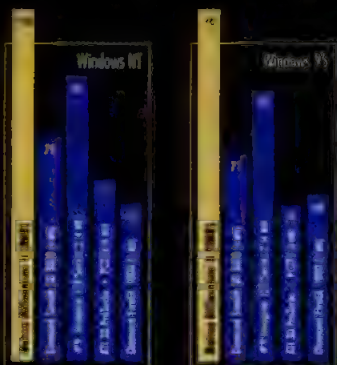
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PC Magazine, June 10, 1997

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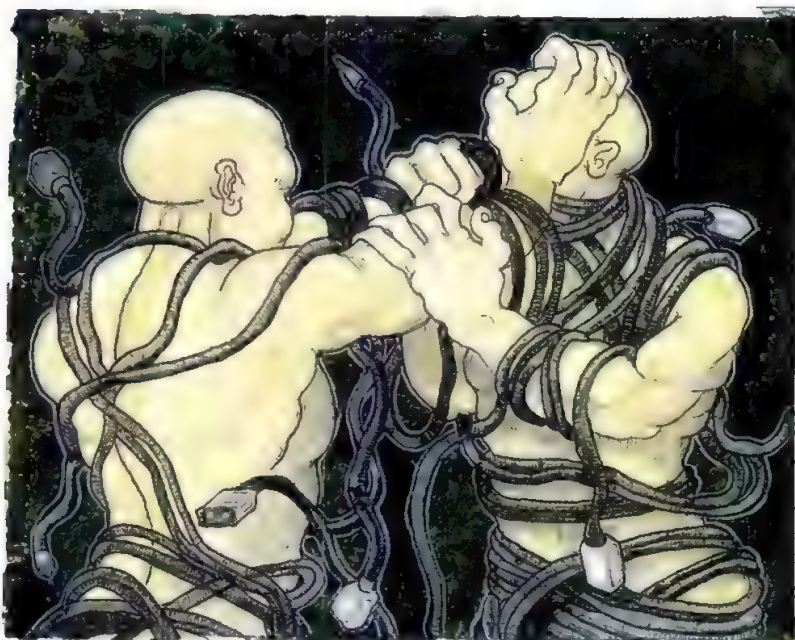
* Estimated street prices. Software bundle available only with retail product. All performance tests conducted by Matrox Graphics Inc. Windows NT 4.0 tests conducted on a Dell Pentium Pro 200 MHz with 32 MB of EDO DRAM and 256K cache. Matrox Millennium II, Diamond Stealth 3D 3000, Number Nine Imagine 128 series 2, ATI 3D Pro Turbo+PC2TV and Diamond FireGL 1000 tested using driver releases 3.06, 2.03, 4.102.21, 3.1.75 and 2.70.4.0.27 respectively. Windows 95 testing was done on a Gateway 200 MHz MMX with 32 MB of RAM and 512K cache using driver release 3.41, 4.03.00.3105, 2.13, 3.03 and 4.03.00.2101.0000 respectively. All boards tested were configured with maximum memory configurations. Winbench 97 business tests conducted at 1024 x 768 @16-bit at 75 Hz using small fonts under Windows NT 4.0 and 95.

NETWORK EDITION

INTRANETWARE VS. NT SERVER 4.0

Two NOSs for the Net

IntranetWare and NT Server both want to be your intranet NOS. But which one is the best all-around NOS solution?



By Frank J. Derfler, Jr., and Tony Pompili

A network operating system (NOS) does more today than ever before. What once was a single product

INSIDE



It wasn't long ago that NetWare was the king of the file and print empire. Then Microsoft started chipping away at NetWare's weak spot—running network applications—and sales of its Windows NT Server took off.

ENTER THE INTERNET and intranet. Microsoft soon realized that Internet and intranet services would become a major mission of most networks. Microsoft Windows NT Server 4.0 added a whole slew of intranet and Internet services, including DHCP, DNS, FTP, and Web servers. Again, NetWare was left behind, struggling to catch up. Now Novell has changed the name of NetWare to IntranetWare and has added most of the same services that you can find in NT Server.

CAN EITHER OPERATING SYSTEM provide all the services today's networks demand? Contributing editor Tony Pompili and the staff of PC Labs set out to answer that question for this Network Edition cover story, putting both NOSs through a battery of performance and usability tests.

A PORT-SWITCHING HUB is one way to get some of the benefits of switching without the expense. In First Looks, contributing editor Steve Rigney compares two port-switching hubs from Hewlett-Packard and LANart. And

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connecting to the Internet while controlling the costs of computing and keeping networks secure and responsive. Novell's IntranetWare and Microsoft Windows NT Server 4.0 now come packaged with Web, DNS, DHCP, and other Internet services that were once available only on Unix platforms. Can either NOS fulfill all of your network, intranet, and Internet requirements? PC Labs tested both products for everything from performance to Internet services and found that the answer is, it depends. The size of your network, your plans for growth, your need for special vertical applications, and your present investment in NetWare will all influence your choice between these two powerful NOSs.

NetWare (formerly marketed as a standalone product, now included with IntranetWare) continues to be the corporate world's de facto standard for file and print services. IntranetWare's powerful, hierarchical NetWare Directory Services (NDS) easily outshines NT Server's flat, domain-based directory as a tool for managing users in large corporate networks. But the number of third-party vendors offering new applications based on Novell's NetWare Loadable Module (NLM) architecture is stagnating, and most vendors developing new server-based applications lean toward NT Server.

DIVING INTO THE NET

Both IntranetWare and NT Server have implemented an impressive range of intranet services. The results of our tests indicate that you can stay with whichever NOS you're most comfortable with today, without having to switch to another NOS

Editors' Choice

• Neither stands out



NetWare (formerly a standalone product, now included

with IntranetWare) and Microsoft Windows NT Server have been playing "Can you top this?" for many years. Yet after all this time, each retains its strengths and weaknesses, and neither fulfills all the needs of today's networks.

IntranetWare retains its superiority as a file and print backbone. We await NT Server 5.0 and its promised Active Directory technology, but for now, managing a large corporate network with NT Server's flat, domain-based naming services is a much more difficult under-

Unfortunately, we found that in both cases, Internet and intranet services are not well integrated with the underlying NOS but rather sit on top of it. For example, both operating systems come with TCP/IP software so that Internet applications can access services, but you'll still probably use IPX because it's faster on the LAN.

A key benefit of running your intranet services in your NOS environment should be the ability to integrate your NOS's administrative user, group, and security controls with your intranet products. It's also

taking than with IntranetWare's robust, hierarchical NetWare Directory Services. Nonetheless, NT Server retains its crown as a server for network applications because of its superior memory architecture, numerous APIs, and support from third-party applications vendors.

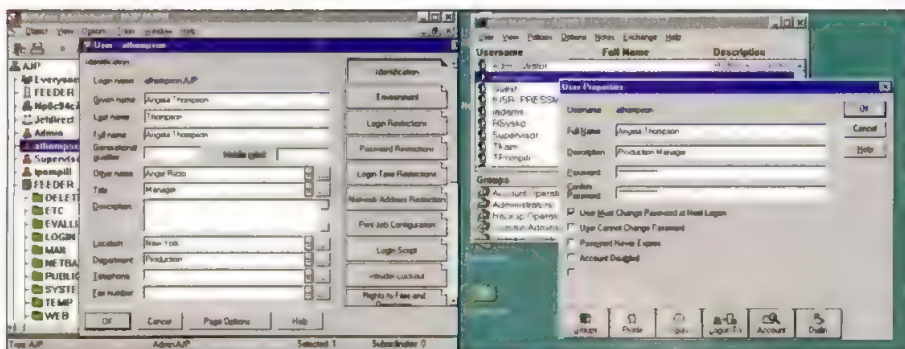
In terms of intranet and Internet services, both NOSs have come a long way. Yet we were disappointed to find that neither NOS has fully integrated its intranet and Internet services into the NOS structure. Instead, these services are handled mostly by bundled applications that run on top of the NOS.

We give Microsoft Windows NT Server, with its robust Internet Information Server and wealth of Internet offerings from third-party vendors, a very slight edge. But the truth is, both NOSs come with good Internet and intranet tools. So if you're more comfortable with NetWare, use IntranetWare for your intranet.

Web server—Microsoft Internet Information Server (IIS)—through its Windows IIS administration program. Microsoft even offers server management over the intranet with its Web Administration for Windows NT Server. IntranetWare continues to use its pervasive C-Worthy interface on the server console with a variety of Windows 3.x, Windows 32-bit, and DOS utilities, such as NWAdmin, to administer common server features.

But neither product really lives up to our expectations for seamless administration.

Both IntranetWare and NT Server use different administrative tools for individual intranet products and traditional NOS services. IntranetWare incorporates print services, users, groups, and rights into NDS, but NDS doesn't interact with many of the intranet products. NT Server consolidated even fewer tasks into its management programs. You can improve NT Server's handling of intranet services and users if you install Microsoft Exchange Server 5.0 and make use of its hierarchical directory services.



INTRANETWARE'S NWAdmin combines user and resource administration in one utility. Windows NT Server has a separate program just for managing users.

to implement an intranet or connect to the Internet. There are more third-party Internet products available for NT Server, but Novell is starting to catch up now that it has partnered with Netscape to bring SuiteSpot to IntranetWare.

more efficient to use as many of the same tools as possible for both environments.

In a few cases, users get familiar tools for managing intranets. NT Server takes advantage of its graphical interface and allows users to configure and administer its

SERVING THE NET

Nevertheless, we were impressed with the useful intranet services available out of the box with both packages. During past PC Labs testing, we found both IntranetWare Web Server 3.0 and NT Server's IIS 3.0

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performing well on our WebBench tests. IIS, in particular, with its built-in search engine and Microsoft NetShow for broadcasting presentations across your intranet, is an impressive enterprise HTTP server.

As for mail and newsgroups, you have to turn to Exchange Server for LDAP, NNTP, and POP3 support in Microsoft's case. Novell plans to incorporate LDAP, IMAP4, NNTP, and POP3 into its groupware product GroupWise later this year.

Both products offer powerful remote access. Microsoft includes a powerful remote-access server in NT Server, while Novell sells NetWare Connect as a separate product. We give NetWare Connect the edge because of its superior monitoring and troubleshooting tools.

MORE THAN A NOS

You don't buy these products in isolation. The comfort of integration goes beyond having intranet services built into your NOS. This is an area where Microsoft excels. Microsoft's BackOffice product line, which includes its SMS software distribution system, SQL Server, and Exchange, was built to run only on Windows NT. Besides being tuned for the Windows NT environment, BackOffice applications also have tight hooks into the operating system, making them easier to use in a cross-application environment. Novell's main offering is its GroupWise groupware and messaging product. Again, GroupWise exploits specific NetWare services such as NDS, making for simple administration.

The combination of traditional NOS services and intranet services is naturally appealing. Although neither product takes complete advantage of this marriage, you'll find that IntranetWare and Windows NT both bring powerful intranet functionality to your LAN, WAN, and users.

Novell Inc.

IntranetWare

Bundling capable Internet services with NetWare's classic networking flexibility and superior directory services, Novell's IntranetWare (\$6,995 list for 100 users) gives NetWare loyalists looking to set up an intranet all they need to stay in the fold. If you're already running Microsoft Windows NT Server 4.0 somewhere on your network, you may be tempted by the wider range of Internet-related applications available for NT Server. Microsoft Internet Information Server 3.0, which comes as part of the NT Server package, also has a few features that the NetWare Web Server lacks. But if you're comfortable with NetWare, there's no good reason to switch to NT Server in order to hop on the Net.

IntranetWare, introduced last fall, is more a bundling of existing NetWare and Novell products than a brand-new release. Besides the standard NetWare NOS kernel, IntranetWare includes Web Server 2.5 as well as DHCP, DNS, and FTP servers.

NetWare Directory Services is, of course, one of the shining components of IntranetWare and far outpaces NT Serv-

er's less functional domain services as a tool for managing large networks. NDS's hierarchical architecture makes it very well suited for creating and segmenting your user, group, and resource management among hundreds of individual sites. NDS's extensible schema and its APIs make it a popular directory service for integrating third-party products.

IntranetWare now comes with symmetric multiprocessing support for up to 12 processors (more than 4 requires the purchase of extra licenses). But its continued use of unstable NetWare Loadable Modules, its lack of sophisticated memory protection, and its dearth of third-party applications make it less suitable as an application server than NT Server is.

NETWARE CLASSIC

Like NetWare, IntranetWare is incredibly easy to install. The installation program automatically detects drivers, CD-ROM drives, and network adapters; it can even assign network addresses automatically. IntranetWare also offers a rich assortment of protocols and card-binding options. Its highly configurable multiprotocol router (MPR) lets NetWare servers augment or replace hardware routers; Windows NT is

SUITABILITY TO TASK

IntranetWare

File and print	Excellent
Administration and management	Good
Directory and naming services	Excellent
Application services	Fair
Internet connectivity	Good

NETWORK OPERATING SYSTEMS

How to Read the Suitability to Task Boxes

File and print We look at the security options available within the file system and whether the NOS allows for a single log-on to the entire network. We also look for support for multiple networking protocols, such as TCP/IP and IPX/SPX, and file systems, such as Macintosh and OS/2 name spaces. We give high marks for extensive client support, including Macintosh, MS-DOS, Unix, and Windows 3.x, 95, and NT, as well as support for 32-bit clients. Support for popular protocols including DLC, IPX/SPX, LPD, and TCP/IP is also a requirement.

Administration and management We evaluate disk system management tools for adding and partitioning disks and monitoring disk errors. We look at how easy it is to manage users, including adding,

moving, and modifying accounts. We examine the configuration tools for adding and modifying network hardware, hard disks, and routing. We look at monitoring tools, including those for network traffic; the number and types of alerts that can be configured; and whether built-in tools to administer third-party software are available.

Directory and naming services

We give high marks to a hierarchical directory structure and the ability to add new fields to the directory. We look for the ability to log on from any location on the network. We also evaluate the database and partition management options available and whether the directory service provides both multiple levels of security for administration and rules-based administration.

Application services We evaluate the number and types of applications development tools available for the NOS, as well as the APIs or other interface tools supported. We give high marks if the NOS provides a protected-memory environment for running applications and if it allows applications to be run across multiple processors.

Internet connectivity We look at the NOS's support for open standards such as ARP, IDAP, and RARP, as well as the number and types of network protocols. We pay particular attention to the NOS's implementation of TCP/IP, and we also look at the types and quality of Internet services provided with the NOS, including DHCP, DNS, FTP, HTTP, and telnet. We look at the types of physical wide-area connections supported, including ISDN, T-1, and frame relay, and whether the NOS includes a multiprotocol router.

SUITABILITY TO TASK

Product Name

File and print	Excellent
Administration and management	Excellent
Directory and naming services	Good
Application services	Fair
Internet connectivity	Poor

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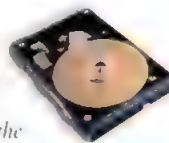
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Medalist Pro 2520	2.5 GB	5400 RPM	11 msec	116 MB/s
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BENCHMARK TESTS

NOSs



Microsoft Windows NT Server 4.0 outperforms Novell's IntranetWare as an application server, although IntranetWare holds its performance edge in file and print services.

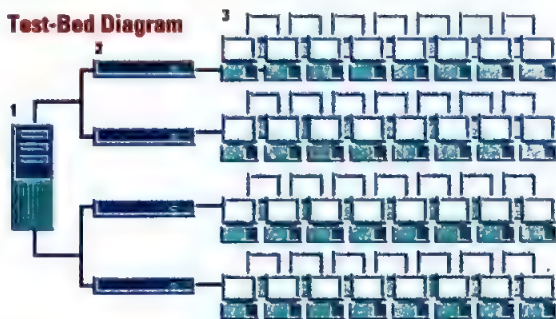
What the Numbers Mean

Our ServerBench test results show that for up to four processors, NT Server's transactions-per-second scores topped those of IntranetWare—in some instances by as much as 28 percent—showing NT Server's superiority as an application server.

IntranetWare continues to dominate when it comes to performance as a file and print server. Starting at 12 NetBench clients, it outperformed NT Server, with the performance gap increasing to 35 percent for the maximum 60-client load.

Novell recommended that we use its Client 32 for our tests to improve InternetWare's performance, and Microsoft suggested that we use IPX with NetBIOS support to enhance client-side caching. The results shown were obtained without these options. To see the results we obtained using Client 32 with

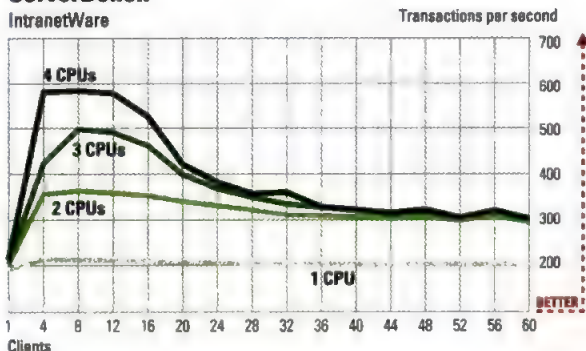
Test-Bed Diagram



(1) Compaq ProLiant 5000 with four Pentium Pro/200 processors, 256MB RAM, and two 10/100 PCI Ethernet adapters. (2) Four Bay Networks Synoptics 28115 10/100 switches with all ports configured for 100-Mbps Fast Ethernet. (3) Sixty Dell Dimension XPS P166s PCs, each with a Pentium/166 CPU, 16MB RAM, and a 10/100 PCI Ethernet adapter.

ServerBench

IntranetWare



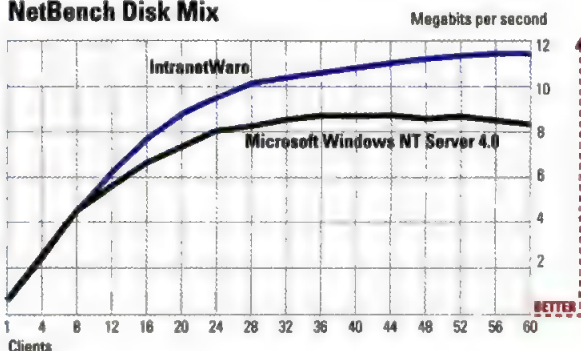
IntranetWare and NetBIOS support with NT Server, go online to www.pcmag.com.—Analysis written by Stephen Chan

How We Tested

We used NetBench 5.01 and ServerBench 4.0. NetBench performs a number of network file manipulations (open, close, read, write) based on profiles of market-leading applications, measuring throughput as clients access files on the server. The benchmark test program starts with a single-client test, then moves to 4 clients and continues to add 4 more clients until a total of 60 clients has been tested. ServerBench simulates a database application's activity to test the NOS as an application server. Clients make requests, such as Finds and Sorts, to applications running on the server.

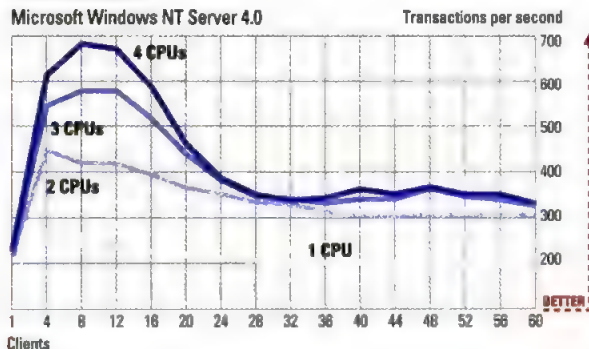
For each benchmark program and NOS, we used a single Compaq ProLiant 5000 as a server test-bed. The ProLiant had 256MB of RAM and four Pentium Pro/200 processors, each with a 512K L2 cache. Of the nine installed Seagate Barracuda 2LP Fast/Wide hard disks, eight were each configured as a single logical volume split equally between two channels on a Compaq Smart-2/P array controller. Software RAID Level 0 was implemented within each NOS for the eight-drive volume that held the test data. The remaining drive housed the NOS itself. The server was connected to two separate 30-client network segments via two Compaq NetFlex-3s (10/100 Ethernet cards). Each of the 60 clients was a Dell Dimension XPS P166s with 16MB of RAM and an Intel Pro 100b (another 10/100 Ethernet adapter). A Bay Networks Synoptics 28115—a 10/100 switch, with all ports configured for 100-Mbps Fast Ethernet—tied everything together.

NetBench Disk Mix



ServerBench

Microsoft Windows NT Server 4.0





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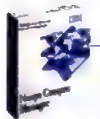
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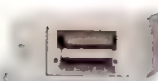
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still getting the hang of this feature.

In case you want to use standard file-server features over IP, IntranetWare lets you replace IPX drivers with NetWare/IP in the client and server. Similar to Microsoft's IP, which encapsulates NT Server's native NetBEUI protocol packets, NetWare/IP encapsulates NetWare Core Protocol (NCP) and other NetWare-specific file and print protocols within IP. Novell is planning a new release of IntranetWare that the company says will use end-to-end native IP and won't require IPX anywhere on the network or server. This release, code-named Moab, is expected out early next year.

On the flip side, Novell also includes an IPX-to-IP gateway. Your clients can continue to run their usual IPX stacks but still have access to the Internet and their intranet through the server-based gateway software.

For Web-browser users wanting to access their organization's intranet remotely, Novell's NetWare Connect 2.0 is a rich albeit complicated remote-access option for IntranetWare servers. Besides working with standard PPP and Novell's Connect clients for incoming calls, it also works with Novell's NetWare Asynchronous Services Interface (NASI) protocols, allowing network administrators to set up shared modem pools. NetWare Connect offers a powerful set of monitoring tools, which we found lacking in NT Server's built-in Remote Access Services (RAS).

YOUR INTRANETWARE INTRANET

A key component of Novell's intranet services is Web Server 3.1; Version 3.0, along with Microsoft Internet Information Server 3.0, received an Editors' Choice ("Beyond Unix," *PC Magazine*, May 27, 1997). Web Server installs as a NetWare Loadable Module (NLM) and is administered using Novell's Windows-based Web Manager package. For Webmasters and Web administrators used to configuring the Web server at the console, IntranetWare's Web Server takes some getting used to, but it is much easier to configure remotely with the graphical interface of the Windows client than by using IntranetWare's menu-driven interface at the console.

It's easy to create drive mappings and then copy and manipulate files on the Web server, just as you would with any other NetWare server. Web Server does not yet have a Java Virtual Machine, as IIS does, so you can't run emerging server-based Java applications. Nor does it offer site management and page creation tools.

Unique to IntranetWare is its NetBasic scripting language. Developed by High

SUMMARY OF FEATURES

IntranetWare vs. NT Server 4.0

■ YES □ NO

Products listed in alphabetical order

	IntranetWare	Microsoft Windows NT Server 4.0
List price (100 users)	\$6,995	\$3,754
General Features		
Minimum RAM/hard disk space	16MB/120MB	16MB/150MB
CPU types supported:		
Intel x86/Digital Alpha	■ ■	■ ■
MIPS/Motorola PowerPC	■ ■	■ ■
Application-memory protection/Symmetric multiprocessing	■ ■	■ ■
Maximum number of processors	12*	32*
Multiprotocol router/Automatic hardware detection	■ ■	■ ■
Native remote access/bandwidth aggregation	■ ■	■ ■
Native backup services/Data encryption across the wire	■ ■	■ ■
Directory and Naming Services		
Hierarchical/domain structure	■ ■	■ ■
Replicated database/Automatic synchronization	■ ■	■ ■
Location-independent log-on/X.500 compliance/LDAP protocol	■ ■ ■	■ ■ ■
Client and Protocol Support		
DOS 3.x or later, Mac OS 7.5, OS/2 2.1 or later	■ ■ ■	■ ■ ■
Windows 3.1/95/NT Workstation 4.0	■ ■ ■	■ ■ ■
AppleTalk/DLC	■ ■	■ ■
IPX/SPX, TCP/IP	■ ■	■ ■
NetBEUI/NetBIOS	■ ■	■ ■
Server Management		
Remote console/Alert notification	■ ■	■ ■
Monitors traffic, memory, and disk use	■ ■	■ ■
Monitors CPU utilization/DMI agent/SNMP agent	■ ■ ■	■ ■ ■
Internet Services		
Web server:		
Supports SSL 3.0/server-based Java	■ ■ ■	■ ■
Supports CGI/ISAPI/NSAPI	■ ■ ■	■ ■ ■
Other server-based interfaces	■ ■ ■	■ ■ ■
Virtual server support	■ ■	■ ■
Access control handled by OS	■ ■	■ ■
Integrated search engine/proxy server	■ ■	■ ■
LPD printing/Supports PPTP	■ ■	■ ■
FTP server/Gopher server/Internet mail server	■ ■ ■	■ ■ ■
Internet mail client/News client	■ ■	■ ■
Web browser/HTML editor	■ ■	■ ■
IPX-to-IP gateway/DHCP server/DNS server	■ ■ ■	■ ■ ■

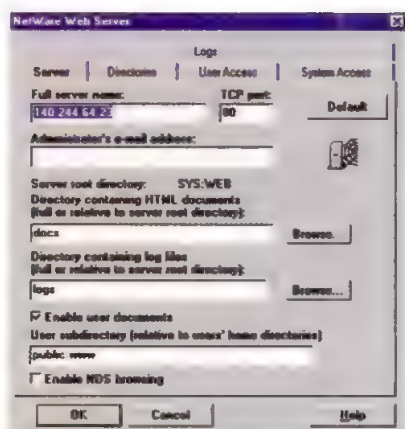
* More than four processors requires the purchase of additional licenses. ** The user must download Web Server 3.1.

Technology Software Corp., NetBasic lets you create scripts in BASIC and call them from your HTML pages. Similar to Java or Microsoft ActiveX, NetBasic runs only on the server. NetBasic makes it easy to create intranet applications. Unlike Java, however, it doesn't port well to non-IntranetWare Web servers.

IntranetWare also comes with DHCP and DNS servers comparable with those of NT Server. As for messaging, Novell offers a separate product, GroupWise 5.1—the latest release—which incorporates IMAP4, LDAP, and POP3 (client-only) support.

ADMINISTRATION NO BETTER THAN NT'S

IntranetWare's management system consists of a variety of configurations and utilities. Some, such as the network configuration utility, INETCFG, run on the console itself; others, like WEBMGR (which manages IntranetWare's Web Server), run on a Windows PC. Since NetWare 4.x, Novell has tried to consolidate some of these utilities. For example, PConsole, Novell's utility for managing printers, queues, and print servers, has had some of its features incorporated into NWAdmin. In the end, however, part of NetWare's mystique involves



IntranetWare's WEBMGR is a separate administration tool just for the Web server.

understanding which tool is right for the individual task. NT Server is little better, though, with its array of management tools scattered throughout the system.

Novell plans to focus on the gray area of networking between your private intranet and the Internet or extranet with a product code-named Border Services. Novell plans to provide firewall, virtual private network, and other services that Novell believes will make it easier to secure the user's private information while still offering access to information. Border Services is expected to be available later this year. In late March, Netscape and Novell announced a strategic agreement to form a new company called Novonyx, with the purpose of bringing Netscape SuiteSpot to the IntranetWare platform.

IntranetWare. List price: For 100 users, \$6,995. Novell Inc., Provo, UT; 801-861-7000, 800-453-1267; fax, 801-228-7077; www.novell.com. **Circle 951 on reader service card.**

Microsoft Corp.

Microsoft Windows NT Server

Web application developers looking for a robust, graphical NOS to create and run intranet applications will find Microsoft Windows NT Server 4.0 (\$3,754 list for 100 users) a good fit. From its Internet Information Server (IIS) Internet-class Web server to its 32-bit application-oriented kernel and memory protection, NT Server continues to outshine IntranetWare as an application platform.

Last summer, Microsoft introduced its newest version, Microsoft Windows NT Server 4.0, with yet more NOS and intranet

belles and whistles, including basic IP and IPX routing, the Windows 95 interface, administration wizards, a network monitor, a new DNS server, and IIS 3.0. Born to be an all-things-to-all-people NOS, NT Server is clearly comfortable serving up file and print services or hosting a variety of 32-bit intranet service applications. The major complaint with NT Server continues to be its lack of directory services. Unlike IntranetWare's rich, hierarchical NetWare Directory Services (NDS), NT Server's flat domain-based directory makes it difficult to divide management, resources, and users into logical business and administrative units. Microsoft intends to fix this deficiency in the next version of NT Server, due to enter beta testing later this year, with its Active Directory. Active Directory will feature a hierarchical structure similar to that of NDS, as well as Active Directory Service Interfaces (ADSI) that will allow developers to create applications that interact with the directory.

Designed to be scalable, NT Server has had SMP support from day one, unlike IntranetWare, which added SMP support only this year. NT Server's implementation, from the ground up, of a 32-bit architecture and memory protection has made the NOS a popular platform for third-party developers. Most of the major Internet server vendors, such as Netscape, offer Windows NT as well as Unix versions of their products. To keep up the momentum, Microsoft's NT Workstation version makes Windows NT an attractive platform for creating applications that run on server and desktop machines, since they both use nearly identical code and share the same development tools.

And Microsoft is poised to add even more application-serving muscle to NT Server. During the summer of 1997, Microsoft plans to ship NT Server 4.0, Enterprise Edition, which will feature improved memory management and support for eight-way SMP out of the box. It will also include phase one of Wolfpack, Microsoft's server-clustering technology, which will allow automatic failover of applications across two NT Server systems connected to a single storage device, as well as Microsoft Transaction server for building and managing distributed applications, and Microsoft message Queue Server, which helps ensure application communication among heterogeneous systems. With the Enterprise Editions of NT Server and eventually BackOffice, Microsoft intends to conquer the high-end application

territory formerly ruled by mainframe and Unix systems.

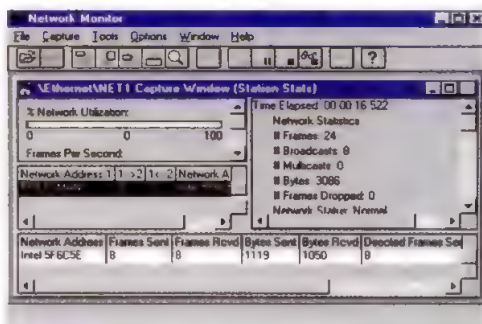
Meanwhile, NT Server continues to court users with its Windows 95 interface, a far cry from IntranetWare's menu-driven environment.

Windows NT invented easy NOS installation. Like IntranetWare, NT Server automatically detects network adapters, hard disks, and other devices during setup, leaving you with little more to do than name the server and choose your network options. You have a choice of installing IIS and various intranet options during setup or adding them later. NT Server 4.0 runs on DEC Alpha, Intel x86, MIPS, and PowerPC systems. The next version will support only Intel and DEC Alpha systems, however.

INTERNET FLEXIBILITY

NT Server doesn't offer native IP, but it encapsulates NetBEUI—Windows' native protocol—in IP packets, as IntranetWare does with its native IPX/SPX protocol. There is, however, no feature similar to IntranetWare's IPX/IP gateway, which allows non-IP users access to IP services such as the Web and FTP servers.

Configuring your network protocols is easy with the Windows 95-like Network Control Panel utility. Besides protocols and bindings, the Network utility program features NT Server's new multiprotocol router (MPR) for AppleTalk, IP, and IPX. NT Server's new router is a welcome but feature-shy addition; IntranetWare's MPR offers greater filtering control and features unavailable with NT Server's new router.



NT Server's new Net Monitor finally brings powerful network analyzer tools to the NOS.

Microsoft's next-generation MPR, code-named Steelhead, is in beta and should be available later this summer. Steelhead will let NT Server dial out over asynchronous and ISDN lines to connect with other Windows NT servers and Internet service providers (ISPs).

The Network configuration program is also used to install intranet services includ-

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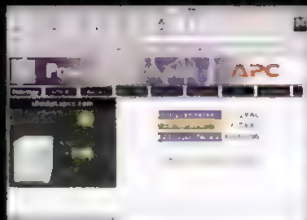
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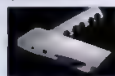


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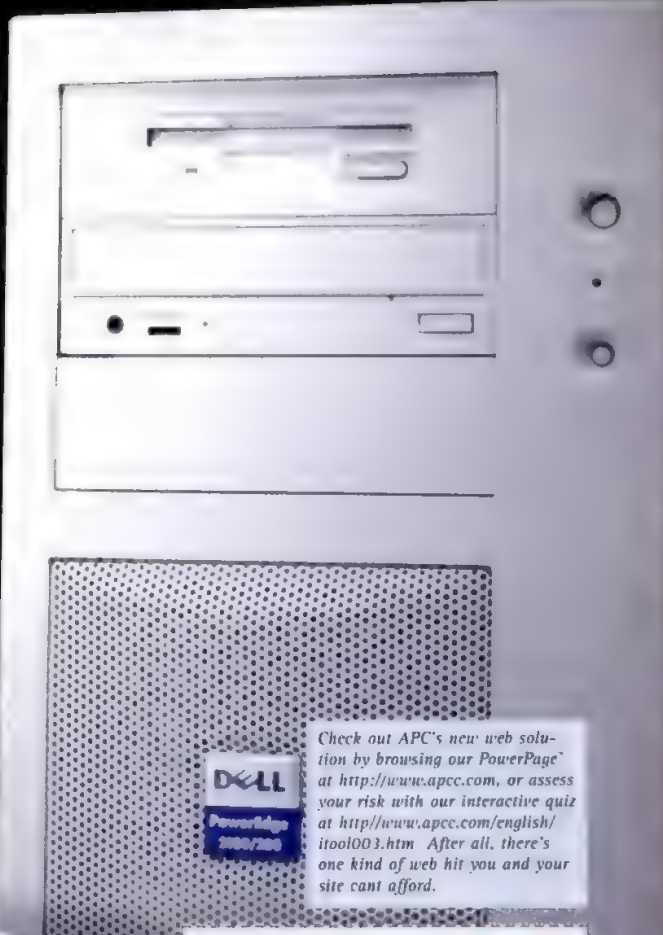


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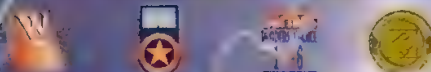
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NETWORK EDITION

COVER STORY

ing the DHCP, DNS, FTP, and IIS servers and to do some of the configuration. As mentioned, Microsoft has put a great deal of effort into its IIS 3.0 server—which, along with NetWare Web Server, received an Editors' Choice ("Beyond Unix," *PC Magazine*, May 27, 1997). IIS incorporates ActiveX technology, which, like Java, lets developers create server-based applications. This architecture also includes Active Data Objects (ADOs) for building Web applications that use ODBC drivers to connect to databases. Besides having a new, full-text search engine called the Index Server and NetShow for broadcasting video and audio across the intranet and Internet, IIS can be administered from any Web browser using HTML-based administration pages. IIS's powerful add-ons, versatile development interfaces, and flexible administration make it a better HTTP server than IntranetWare's for building Web sites.

SUITABILITY TO TASK

Microsoft Windows NT Server 4.0

File and print	Good
Administration and management	Good
Directory and naming services	Poor
Application services	Excellent
Internet connectivity	Good

where. In the next release of NT Server, expected early in 1998, Microsoft says it will include a general-purpose management application, called Microsoft Management Console, for consolidating management tasks. This will let Microsoft and third-party developers create custom code to configure and administer their unique products. Vendors' product code would then be added to the Management Console, allowing administrators to use a single interface for managing a variety of services.

JUST TRY TO FIND US

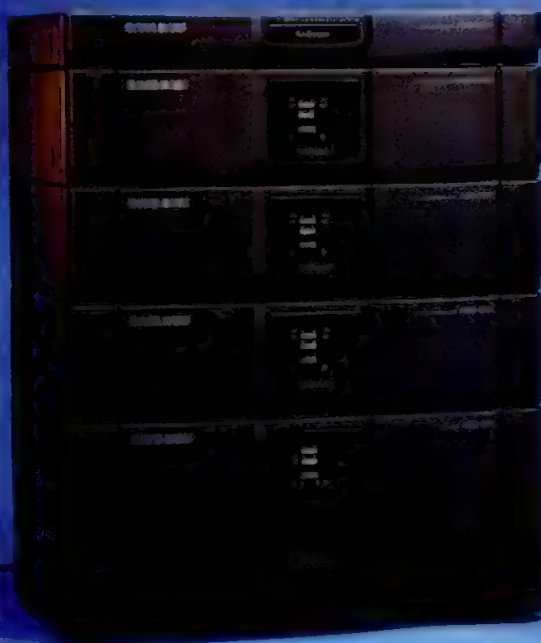
Like IntranetWare, NT Server administration of its intranet and other server components leaves a little to be desired. NT Server lets you run its administration utilities on the server, but the utilities are scattered. Tools such as User Manager for managing user accounts in Domains are in one location, while IIS and other administration tools are located else-

AN INTRANET BEYOND NT SERVER

While most of NT Server's intranet services come standard, standards-based messaging services are included only with Microsoft's Exchange Server 5.0. Exchange comes with an LDAP as well as POP3 mail, an NNTP news server, and an SMTP mail gateway. Exchange is but one of several of Microsoft's BackOffice applications designed to run on Windows NT. Other products include Systems Management Server for distributing software across the network, an SNA gateway for communicating with IBM mainframe networks, and a SQL Server for a database. Although it's catching up with IntranetWare's strong networking and routing capabilities, and about to offer useful directory service, NT Server is still holding its own when supporting powerful and scalable server-based applications. □

Microsoft Windows NT Server 4.0. List price: For 100 clients, \$3,754. Microsoft Corp., Redmond, WA; 800-426-9400; www.microsoft.com. Circle 952 on reader service card.

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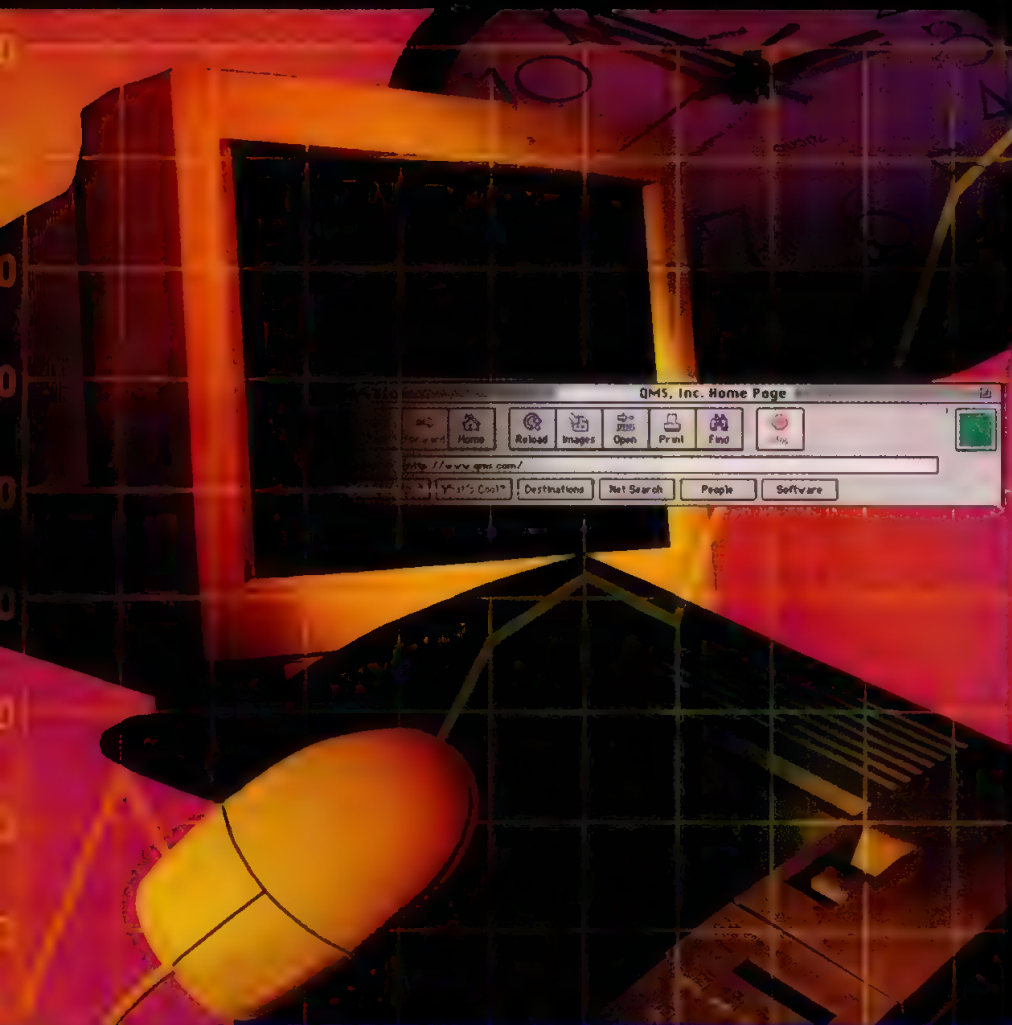
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By Tony Pompili

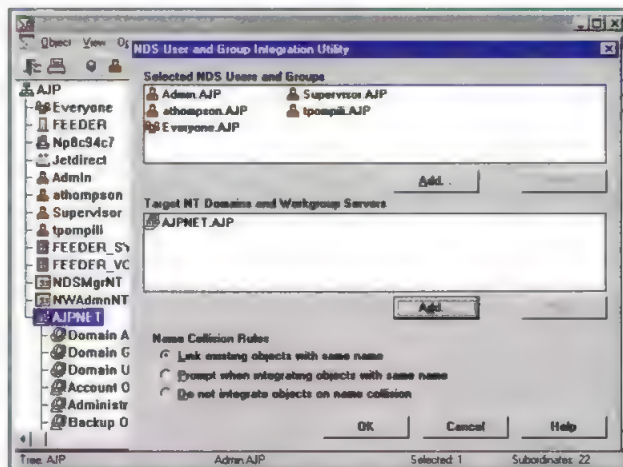
Synchronicity for NT Server 1.1 (starting at \$4 per user account, list price) is the first in NetVision's series of directory administration products, which are aimed at reducing user administration in heterogeneous NOS and messaging environments. Sometimes referred to as a *metadirectory*, Synchronicity lets you create users and groups for both NetWare and Windows NT environments from a single directory. You can link existing Windows NT and NetWare user accounts and make changes to them in a single step.

NetVision has wisely developed Synchronicity around Novell's NDS (NetWare Directory Services), using NWAdmin and some Synchronicity add-ins. This makes the product easy to set up, implement, and learn. By contrast, Zoomit Corp., another metadirectory vendor, chose to rewrite the central directory repository of its product VIA from the ground up, an approach that may add another management interface for you to master.

We tested Synchronicity 1.1 on Microsoft Windows NT Server 4.0 and IntranetWare 4.11; it can run on Windows NT 3.51 as well. Regardless of your choice, you'll need to download NetWare Client for Windows NT. Synchronicity uses NetWare Client to log in and authenticate with the NDS for the NetWare server.

Two software additions to the Windows NT and NetWare environments make Syn-

chronicity work: the Global Event Server (GES) NLM, which runs on the NetWare server, and the complimentary Synchronicity for NT, for NT server. The NLM and the agent communicate point-to-point, so there's little broadcast traffic.



NO MORE MISSING LINKS: Synchronicity for NT Server 1.1 lets you link users and groups in NetWare and Windows NT environments.

The whole system works like this: You make a change to the NDS, such as creating or deleting a user. GES senses the change by polling the NDS event manager and notifies the Synchronicity agent, which updates the Windows NT directory. If your Windows NT servers are in a single or trusted Windows NT Domain, the Synchronicity agent can run on only one server; otherwise, it must run on each standalone server or workstation.

Synchronicity stores Windows NT accounts, groups, and other attributes in new Windows NT Domain container objects. It automatically adds

these objects during setup, as well as including over a dozen other NDS schema extensions. The program works over IPX/SPX or TCP/IP.

What can you actually do with Synchronicity? For daily administration, you can perform most individual-user and group basics, such as changing passwords and names and assigning rights. If you've linked Windows NT and NDS ac-

several accounts with NDS or Windows NT accounts, as well as create a batch of new accounts. Changes you make to NDS take effect nearly immediately on each NOS platform.

NetVision understands that administration is not always a centralized task. So it lets local administrators still use Windows NT's User Manager for Domains to manage Windows NT accounts without concern for account links managed by Synchronicity. According to NetVision, however, limitations in Windows NT's event trapping make it impossible to make changes back to NDS in real time. As an alternative, NetVision provides Resynchronization Actions, which periodically parse the Windows NT directory for changes and push updates to NDS.

Although Synchronicity is available now only for Windows NT, NetVision has announced versions for a variety of platforms, including Lotus Notes, Exchange, and NetWare 3.x running Bindery Services. It has also announced a version that works with directory services communicating with LDAP (Lightweight Directory Access Protocol). The Notes and Bindery versions should be available by the time you read this.

NetVision has taken an intelligent and practical approach to enterprise user and group management. We look forward to the upcoming release of Synchronicity, which should be a hit with any enterprise manager.

Synchronicity for NT Server 1.1. List price: \$4 to \$14 per account. NetVision Inc., Orem, UT; 801-764-0400; fax, 801-764-0600; www.netvisn.com. Circle 955 on reader service card.

PORT-SWITCHING HUBS

Segmentation Made Easy

By Steve Rigney

Most network administrators know that the easiest way to alleviate heavy traffic is to break the LAN into segments, but this task can be time-consuming on a large network. One easy solution is to use port-switching hubs—10Base-T hubs with multiple internal segments built into the chassis. In this roundup we look at Hewlett-Packard's AdvanceStack Switching Hub and LANart's SegWay Adaptive Micro-Segmentable Hub, two of the few port-switching hubs on the market that provide load balancing.

Hewlett-Packard Co.

AdvanceStack Switching Hub

The AdvanceStack Switching Hub doesn't provide as many internal segments as the SegWay, nor does it offer dynamic load balancing. But its management software is easier to use, and you can stack eight hubs together (for a total of 192 ports), compared with only five with the SegWay. You can also manage all of your HP port-switching hubs and other HP devices from a single PC.

The AdvanceStack line consists of 12- and 24-port 10Base-T hubs (with list prices of \$759 and \$1,339 respectively) as well as a management module (included in the base price) and an optional Switch Module (\$949), which connects to the back of the AdvanceStack. The Switch Module allows communication among segments and provides connections for other network devices, such as switches and routers. Like the SegWay, the AdvanceStack includes both

SNMP and RMON management agents.

The AdvanceStack is extremely easy to install, and it supports both IP and IPX. By default, it assigns the ports to the four internal segments in a round-robin fashion. To change a port's setting or implement load balancing, you have to configure the hub either through a terminal connection or over the network with the easy-to-use management software.

Unlike the SegWay, the AdvanceStack provides static rather than dynamic load balancing. You use the management software to monitor the network, then have it assign ports to segments based on a traffic pattern.

While network administrators may prefer dynamic load balancing, which automatically adjusts port assignments based on real-time traffic, static balancing may be better for monitoring the network's health over time, since a monitored port doesn't hop from segment to segment.

Our favorite part of the package is the Windows-based Assistant, which you use to



ADVANCED MATHEMATICS: The AdvanceStack uses static load balancing to segment a LAN.

configure load balancing, monitor network usage, watch for errors, and generate alarms for your AdvanceStack hubs and other HP devices.

Like the SegWay, the AdvanceStack lets you set up redundant ports and cables but

limits you to four. Also like the SegWay, it provides security for individual ports. You can disable any port or assign a specific MAC address to it; if a user tries to connect a PC to a wrong address, the connection will be refused.

AdvanceStack Switching Hub. List price: 24-port model, \$1,339. Hewlett-Packard Co., Palo Alto, CA; 800-752-0900; www.hp.com. Circle 953 on reader service card.

LANart Corp.

SegWay Adaptive Micro-Segmentable Hub

LANart invented the first port-switching hub, and its latest product, the SegWay Adaptive Micro-Segmentable Hub (\$2,235 list), is the only one we've seen that supports dynamic load balancing. It provides 24 10Base-T ports, eight internal LAN segments (as opposed to four with HP's AdvanceStack), and an SNMP agent, in a single rack-mountable chassis. The only major drawback is the lack of a graphical utility for configuring segments and monitoring traffic across the segments.

In addition to the 24 10Base-T ports, the chassis has eight backplane (or channel) ports that define the internal LAN segments. You can attach them to other network devices, such as switches and routers, or use them for redundancy in case a segment fails. You must connect the backplane channels to an external switch to allow communication among segments. You can also use a router to connect them to a single file server.

LANart also offers the SegWay Port Switch Expansion module (\$1,365 list), which has 24 ports. The SegWay can

support up to four modules, for 120 ports and eight LAN segments. In addition, a couple of the chassis's most helpful features are the large LED display and the joystick for monitoring and configuring the hub.

The SegWay is fairly easy to install, but learning how to change the default settings can take a while. By default, it routes all of the ports on the box to the first LAN segment. You can configure load balancing and segment the ports using the front-panel joystick or Terminal Manager, a program you access via a serial or telnet connection. Terminal Manager also lets you monitor segments and ports and collect network statistics.



TAKING THE STICK: SegWay's joystick helps you configure the hub.

The SegWay includes two traffic-management features: dynamic load balancing and Fail-Over. Dynamic load balancing automatically assigns and reassigns ports to segments based on real-time traffic. If a segment becomes too crowded, SegWay can move some users to another one without intervention. In contrast, HP's AdvanceStack requires you to handle load balancing manually.

With Fail-Over, you can configure any port on the hub, including any of the backplane ports, as a spare connection. If a connection goes down, the redundant port will kick in automatically.

SegWay Adaptive Micro-Segmentable Hub. List price: \$2,235. LANart Corp., Needham, MA; 800-292-1994; www.lanart.com. Circle 954 on reader service card.

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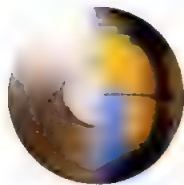
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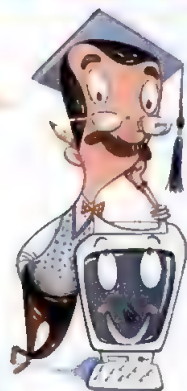
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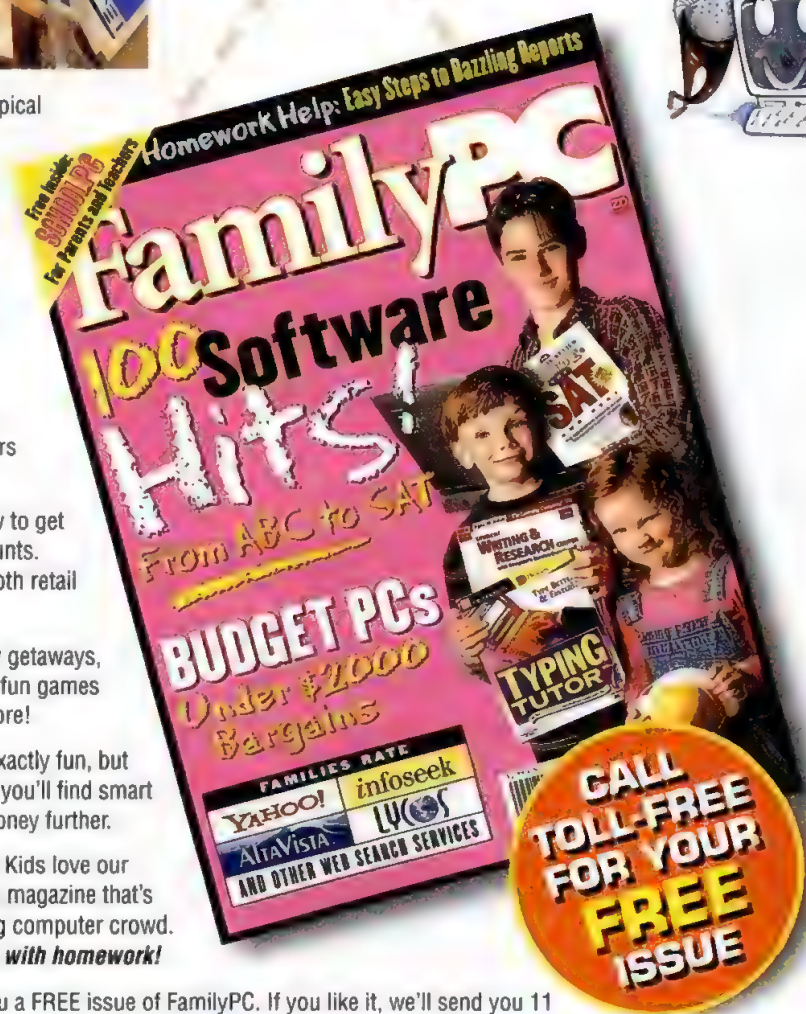
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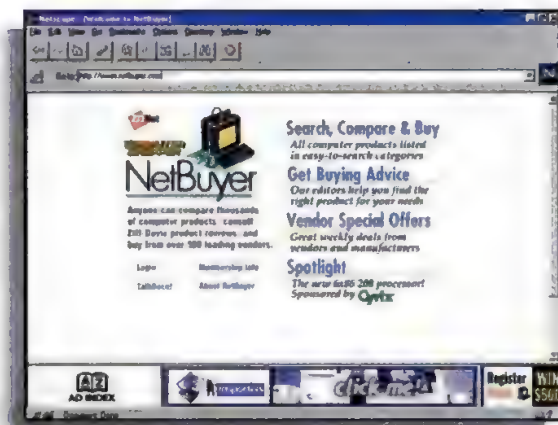
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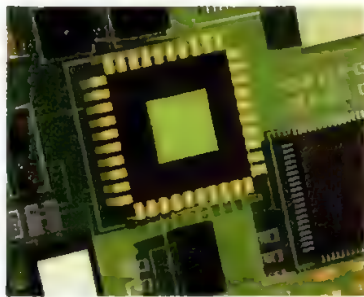
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DESKTOPS

The dream PC, the office PC, the home PC, the home office, and the PC TV, *page 102*, plus desktop CPUs and components, *page 122*.



HOW TO CHOOSE THE PERFECT



PORTABLES

The dream notebook, the value notebook, and the lightweight notebook, plus portable CPUs, connections, and multimedia components, *page 132*.

ILLUSTRATIONS

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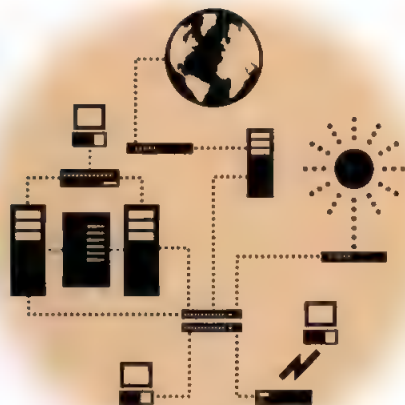
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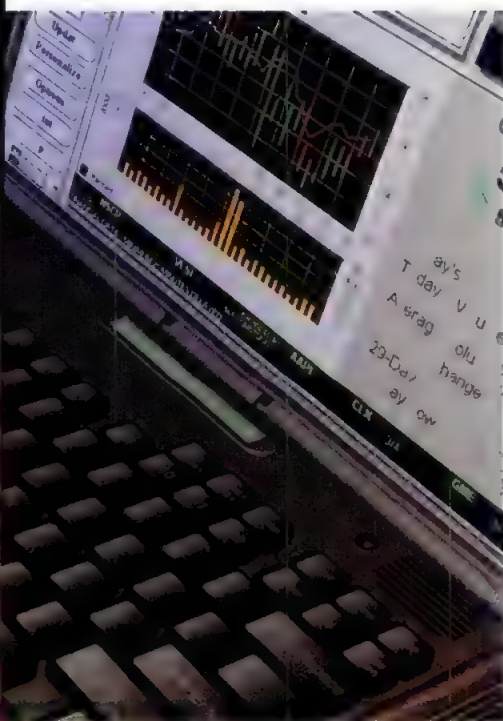


NETWORKS

The server, hub and adapter, workgroup switch, and branch-office router, along with remote access, Internet connections, storage, and the small office, page 156.



PC



Picking the Perfect PC has never been more difficult. More companies offer more components than ever. While this affords a wide array of choices, it can also be confusing, whether you're walking into a store, ordering over the phone or the Web, or building a machine from components. In the pages that follow, we try to make the process easier. We've distilled the past year's worth of reviews and lab tests into idealized versions of various kinds of PCs. For each of the "Perfect PCs," we recommend specifications and components. This year, we look at three major categories: desktops, portables, and network connections. In "Perfect Desktops," we've broken down PCs into more categories than ever. We still offer our recommendations for configuring a "dream machine," but we also cover more realistic configurations for large offices, small or home offices, homes, and PC theaters. Then we give you more details on graphics, storage, and multimedia components as well as processors and peripherals. And we add a worksheet that lets you tweak our recommendations into a configuration that's right for you, with space for notes and price quotes on desktop and portable PCs. Similarly, in "Perfect Portables," you'll see our recommendations

PC Magazine's advice for well-configured PCs, portables, and networks.

for a "dream notebook," a value notebook, and a lightweight notebook. We also mention some perfect notebook accessories. In "Perfect Networks," you'll find our specifications for various parts of networks for small and large organizations. These parts include servers, hubs, switches, routers, storage devices, and Internet connections. Rounding out the issue are our annual surveys of PC service and reliability and software support and satisfaction. We're sure you'll be interested in what your fellow readers think of the companies that make the hardware and software we all rely on. You'll also find the PC Magazine 100, our new list of the 100 most influential PC companies. We hope all this information makes it easier for you to choose the specifications, and then the PC, that will be right for your needs. After all, the Perfect PC is the one that is perfect for you.

—Michael J. Miller

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You can online to take advantage of the best deals on the best PCs and components.

Perfect Desktops

THE DREAM PC

If you can afford to spend the price of a decent midsize car on a computer system, our dream PC is for you. Make no mistake, however: This machine is not for those who spend most of their time with office-suite applications. The dream PC is outfitted specifically for high-end applications, including imaging, CAD, engineering, large databases, and the like. In other words, it's not a PC; it's a power user's workstation. 🐉 At the heart of this machine lies Intel's newest P6-class microprocessor, the Pentium II (just introduced in May). Our suggested configuration specifies the 300-MHz version of the CPU. You should be aware, however, that this part will be in very limited supply for the next few months and will likely be carried only by the large vendors of x86 workstations. 🐉 For the dream PC's operating system, we suggest Microsoft Windows NT Workstation 4.0. This powerful and relatively stable 32-bit OS provides extensive security features, as well as SCSI optimizations to make the most of your storage subsystem. You may also want to consider a large-format removable storage device (such as a Jaz drive) for transferring large amounts of data. 🐉 Price: About \$16,000.—Carol Venezia

DOLBY DIGITAL (AC-3) *An audio recording technology with surround sound. AC-3 provides five channels (front left, right, and center, and rear left and right) plus subwoofer.*

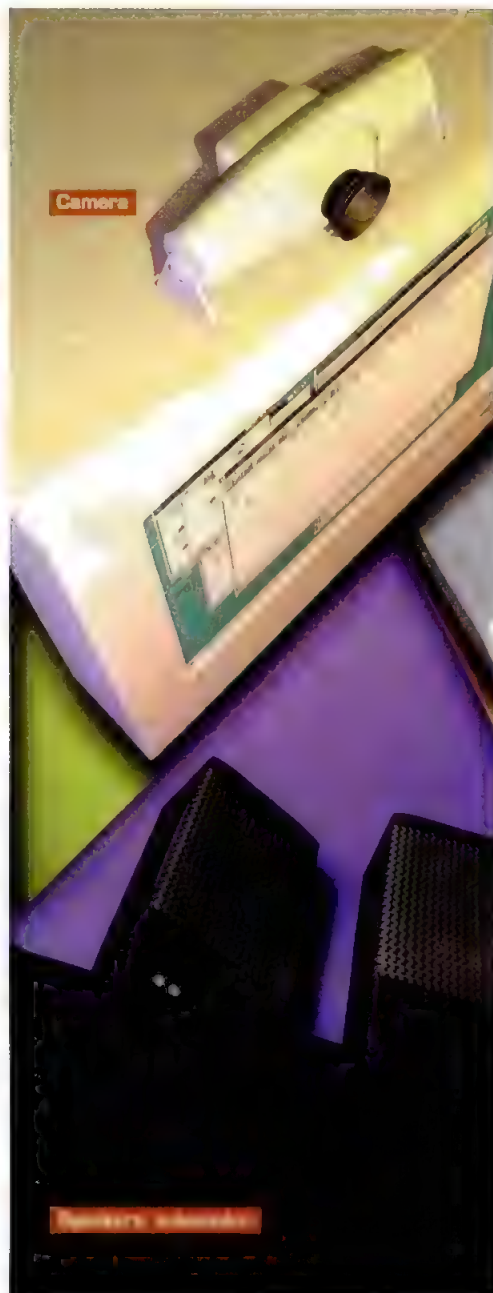
DVD (DIGITAL VIDEO DISK OR DIGITAL VERSATILE DISK) *A high-capacity storage medium. DVDs are the same diameter as traditional CDs but can be recorded on both sides. DVD drives currently available are DVD-ROMs (read-only memory), which read CD-ROMs at 8X speed and play video CDs. Standalone DVD players are compatible with audio CDs, CD-ROMs, CD-I disks, and video CDs but not first-generation CD-R disks.*

MPEG-2 *A compression scheme for full-motion video for a range of video and broadcast applications. MPEG-2 supports a resolution of 720 by 480 pixels at 30 frames per second with full CD-quality audio.*

OPENGL *A 3-D graphics language developed by Silicon Graphics and endorsed by numerous vendors, including all major manufacturers of graphics accelerator boards. Microsoft Windows NT 3.5 or later supports OpenGL.*

RAID (REDUNDANT ARRAY OF INDEPENDENT DISKS) LEVEL 0 (striping). *A specification that interleaves data across multiple hard disks for better performance than with a single hard disk. RAID Level 0 does not provide safeguards against disk failure as higher RAID levels do.*

ULTRA WIDE SCSI *A specification that supports a 16-bit-wide bus (double the width of narrow SCSI), transfer rates up to 40 MBps, and a maximum of 16 connected devices. Typical Ultra Wide SCSI disks spin at 7,200 rpm. Also called SCSI-3 or Fast-40.*



Dual 300-MHz Pentium II CPUs Intel's new flagship processor integrates 512K of L2 cache per CPU, plus MMX.

128MB of EDO ECC RAM To protect data integrity, outfit your dream PC with error-correcting-code memory.

DVD Drive This cutting-edge piece of hardware reads traditional CD-ROMs at 8X speed. DVD content currently available includes mostly movies, reference, and edutainment titles.

4-mm DAT Drive To back up critical



data, look for a DAT drive that closely tracks hard disk capacity.

120MB Floppy Disk Drive This device reads traditional 1.44MB floppy disks and allows backup of large single files such as images.

Two 4.5GB Ultra Wide SCSI Hard Disks For top performance, configure your 7,200-rpm disk subsystem in a RAID Level 0 (striped) array.

300-Watt Power Supply Check with the vendor to ensure that the power supply in your machine has enough

capacity and connectors to handle additional devices.

16MB OpenGL Graphics Card Look for a board that can handle a top resolution of 1,600-by-1,280 at an 80-Hz refresh rate.

Single-Channel Ultra Wide SCSI Adapter For faster disk performance, add RAM to this card.

DVD Adapter First-generation DVD drives require adapters to decode MPEG-2 video and Dolby Digital (AC-3) audio.

10/100-Mbps Fast Ethernet Adapter This card can be used either for speedy LAN connections or to hook up an xDSL or cable modem.

Wavetable Sound Card This device should be Sound Blaster-compatible.

Other Components The dream PC should also include high-quality speakers with a subwoofer, a modem (cable, DSL, 56.6-Kbps, or ISDN, depending on service availability in your area), a 21-inch monitor, and a camera (USB, if available) for videoconferencing.

Perfect Desktops

THE OFFICE PC



he office PC is no longer simply a collection of hardware screwed into a plastic and metal chassis with a monitor and a network card. Today's office machines must be smart, and they must be manageable. Many PC vendors are addressing these issues with innovative new hardware and software features. As a buyer, you should expect no less. Our perfect office PC would be a good choice for a high-level office worker who primarily uses e-mail and productivity applications. Your employees' needs may differ, and in some cases a NetPC or NC may do the job. Either way, you should take stock in what your employees are doing before filling out the RFQ. Price: About \$3,000 to \$4,000.—Carol Venezia

What the Manageable Office PC Needs

DMI COMPLIANCE *All PCs that are connected to a corporate LAN should comply with the DMI 1.1 specification. The 1.1 spec allows network administrators to inventory system components and settings without physically opening the box; the 2.0 spec will expand on this concept to add remote manageability.*

MIF BROWSER *Many large system vendors write software—specific to their PCs—to facilitate manageability. A MIF (management information file) browser is a management application that lets you query the system for hardware and software component information.*

32-BIT SERVICE LAYER *If you want to manage a PC remotely over the network (using network management applications such as HP OpenView), that PC must have a 32-bit service layer. This service layer is code that arbitrates access to component instrumentation and manages the PC's MIF database. DMI 2.0 should bring with it shrink-wrapped solutions (with service layers provided by Intel, among others), but until then, you'll have to rely on your PC vendor.*

WAKE ON LAN *PCs from a handful of vendors support this IBM spec, which lets network administrators remotely power up a PC in order to update files, perform asset tracking, and inventory equipment without leaving their consoles. Although Wake on LAN is not widely used right now, it should be in the future.*

SERVICEABLE DESIGN *If you've ever had to service a PC, you know that a tool-free chassis doesn't necessarily mean painless maintenance. Most large system vendors have spent plenty of time and design dollars addressing the issue of serviceability. Look for PCs that provide quick interior access (once security features have been disabled, of course), removable motherboards, clutter-free cabling, and so forth. The NLX motherboard spec addresses ease-of-service issues (see the section "Desktop Components" for more details).*

PREFAILURE WARRANTIES *Many vendors now also offer prefailure warranties for major PC components including CPUs, hard disks, and memory.*



200-MHz CPU with MMX You may not think you need MMX in the office, but if you're concerned with investment protection, you should seriously consider it. Both AMD (K6) and Intel (Pentium) offer various speeds of MMX CPUs (up to 233 MHz for both).

256K of L2 Cache Up this configuration to 512K if you're working with processor-intensive apps.

32MB of RAM If your OS is Windows 95, 32MB should suffice; if you're running Windows NT, double it.



12X/16X CD-ROM Drive While a slower-speed drive is certainly sufficient, many vendors are equipping their PCs with variable-speed 16X devices.

Floppy Disk Drive Upgrading to a 120MB floppy disk drive allows you to transfer larger files while still letting you use standard 1.44MB floppy disks.

2GB EIDE Hard Disk This capacity is the bare minimum you should consider.

200-Watt Power Supply Many business PCs come with 100- or 140-watt power supplies; 200 watts is plenty for most.

4MB PCI Graphics Board This configuration allows you to display 1,280-by-1,024 true color (16.7 million colors, or 24-bit color) or 1,600-by-1,200 high color (65,000 colors, or 16-bit color). A 2MB graphics board may save a few dollars but the highest resolution you'll be able to reach is 1,024-by-768 16-bit color, or 800-by-600 24-bit color.

Integrated Components The desktop or slimline case used by many business PCs demands tight integration. Look for a PC with Sound Blaster-com-

patible audio, two USB ports, and Fast Ethernet (selectable 10/ 100 Mbps) integrated on the motherboard.

Case Lock Many PCs feature hardware case locks and Kensington loops.

17-Inch Monitor with Integrated Speakers A 17-inch unit costs only \$200 to \$300 more than a 15-inch model and is well worth the investment. Integrated speakers save desk space and allow playback of business-level audio.

Keyboard and Mouse Consider an ergonomic keyboard with wrist rest.

Perfect Desktops

THE HOME PC

Outfitting your home PC is as much a matter of personal taste as choosing new furniture or buying a car. Carefully consider who's going to be using the PC and what they're going to be using it for before you go shopping. 🐸 Our perfect home PC is powered by a processor with MMX technology, because we believe that MMX is a must for consumer multimedia and gaming applications. Many vendors bundle their MMX PCs with MMX-enabled software, including games and image-editing packages. Also keep an eye out for USB peripherals. A few devices are just coming to market now, including speakers, keyboards, and joysticks. Price: About \$3,500. 🐸 Another type of home computer that is gaining much attention from buyers, vendors, and the trade press alike is the so-called \$1,000 PC. A number of large home PC vendors have recently entered this market, most with quite credible and complete systems. If your budget will not allow for much more than \$1,000 for a computer, you do have options, but—as with our perfect home PC—shop carefully, and consider what you'd like to do with your new PC before you buy. At the very least, the machine should have 16MB of RAM (32MB is preferable, and memory prices are such that an upgrade shouldn't break the bank), wavetable sound, a 2GB hard disk, a CD-ROM drive, and a modem. —Carol Venezia

Other Components

56-Kbps Modem Depending on the availability of service in your area, you may opt for a cable modem, an xDSL (digital subscriber line) modem, or an ISDN modem. If you choose cable or xDSL, you'll need a 10-Mbps Ethernet card to connect it to your PC (typically installed by the company that connects the modem). But remember also that cable modem service is far from widespread (with only about 20,000 connections active in the U.S. today), and xDSL is even more rare.

Two USB Connectors USB peripherals are scarce right now, but by year's end they won't be. Make sure that your home PC is ready for them when they arrive.

17-Inch Monitor You'll pay about \$300 more than what you'd pay for a 15-inch monitor, but a 17-inch screen lets you display a resolution of 1,024-by-768 comfortably. This

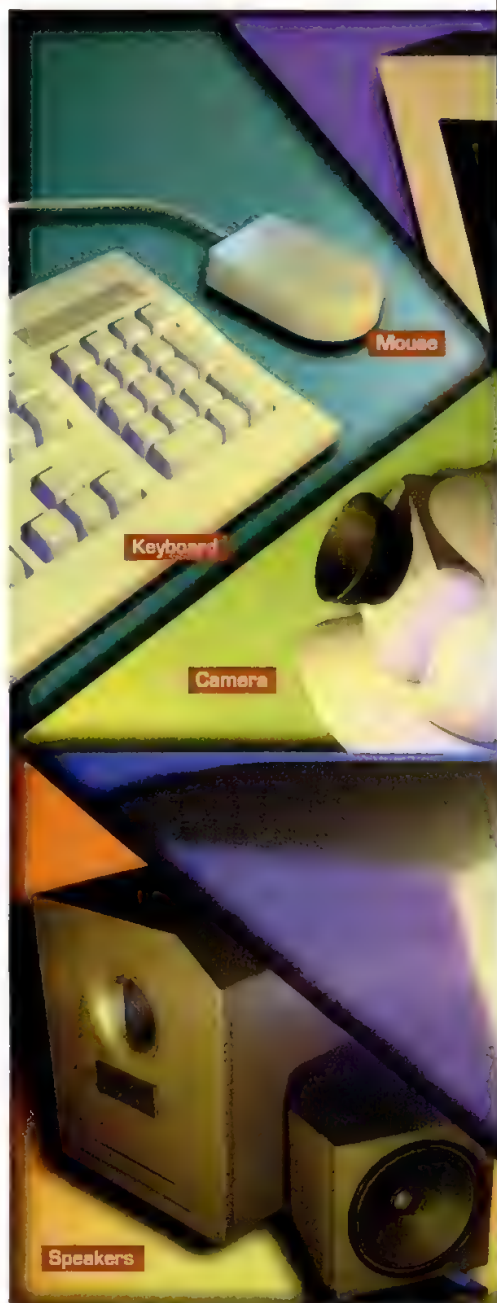
device should also support a dot pitch of 0.28 mm or less.

Video Camera For videoconferencing with the office or distant relatives, a camera is a must.

250Va UPS (Minimum) Because it's unlikely that you have a dedicated circuit for your PC, you should have a UPS (uninterruptible power supply) to save critical data when someone overloads the household circuit.

Speakers with Subwoofer and Wavetable Sound Card For top-quality audio from your home PC, you need good speakers with a subwoofer (the latter is necessary for good, audible bass tones) plus wavetable audio support. You may need to upgrade both over standard-issue bundled devices.

DVD Adapter If you decide to get a DVD drive, it must have a PCI adapter for AC-3 and MPEG-2 decoding.



233-MHz CPU with MMX To protect your home PC investment, we suggest you buy ahead of the technology curve. A processor with MMX (from AMD, Intel, and soon Cyrix) speeds common multimedia functions when coupled with the appropriate software.

512K of L2 Cache You get a slight speed boost from extra L2 cache, and for less than \$100 over what you'd pay for 256K, it's worth the price.

32MB of EDO DRAM For a Windows 95 PC, 32MB of RAM is the least



you should consider. If you're running memory-hungry applications, you should double this configuration while RAM is still cheap (many vendors offer upgrades to 64MB for less than \$200).

DVD or 16X CD-ROM Drive DVD drives (which read DVD movie titles, DVD-ROM data disks, existing audio and data CDs, and DVD audio titles once they're available) are just becoming available from some vendors. Since DVD is a new medium, content is not yet plentiful. We suggest at least a 16X

CD-ROM drive if you don't see an immediate need for DVD.

Removable Storage For shuttling files to and from the office, or for off-line storage of valuable data, consider a 1GB to 1.5GB removable storage device (such as a Jaz or SyJet drive) or at least a 100MB to 200MB device such as a Zip or EZFlyer drive.

Floppy Disk Drive Consider a 120MB floppy disk drive (backward-compatible with 1.44MB disks) for additional "portable" storage.

3.5GB EIDE Hard Disk (Minimum)

We'd suggest buying the biggest disk you can afford, because Windows 95 and its apps take up more space than you might think. SCSI costs more and performs better for demanding users.

200-Watt Power Supply If you plan to add peripherals—particularly fixed storage devices—check out PC power requirements first.

4MB PCI Graphics Board This card should also support 3-D for gaming.



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1997 BUYERS' GUIDE

HOW TO

PC Magazine's summary of buying advice for

business, home, and dream desktop and

notebook PCs, plus buyers' worksheets and

background information on key vendors.



In this gatefold we give you a summary of key features and buying issues as well as a table with contact, warranty, and technical-support information for vendors included in our Service and Reliability Survey (page 181).

This year we've added several up-and-comers and dropped those that no longer actively market PCs. We've also included buyers' worksheets for both desktops and notebooks with our recommended specs, and we've left room for you to list your candidates' features. ☞ Some of our component recommendations may seem high-end. But as the cost of components falls, it makes sense to buy not only what you need today but also what will keep your system useful for the next two or three years. ☞ CPUs include a wide range of choices from Intel (your best bets are the Pentium MMX and Pentium II) and solid contenders from AMD and Cyrix. Most users should look for either the fastest or the second-fastest CPU available and pair that with 512K (not 256K) of L2 cache and 32MB of RAM, or 64MB if you're running Windows NT. ☞ Seriously consider 17-inch monitors, which can easily display 1,024 by 768 pixels, and get a graphics card with 4MB of memory to allow true color at that resolution.



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www.pcmag.com

THE PERFECT PC

BY MARY E. BEHR AND ANUSH YEGYAZARIAN

Buyers' Worksheet: Notebooks

FEATURE	HIGH-END NOTEBOOK	VALUE NOTEBOOK	LIGHTWEIGHT
Processor	Mobile Pentium MMX/166	Pentium MMX/166 (or classic Pentium)	Mobile Pentium MMX/166
L2 cache	256K	256K	256K
System memory	32MB	16MB	16MB
Hard disk	3GB	1.2GB	2GB
System weight	8-plus lbs.	6-7 lbs.	5 lbs.
Screen	13.3-inch XGA TFT	11.3-inch or larger SVGA DSTN or VGA TFT	12.1-inch SVGA TFT
Graphics card memory	2MB VRAM, 64-bit	1MB VRAM (minimum), 64-bit	2MB VRAM, 64-bit
Battery	Primary: lithium ion; secondary must be swappable	Lithium ion or nickel hydride	Lithium ion
Floppy disk drive	Swappable for CD-ROM drive, second battery (in some cases, an MPEG module or Zip drive is an option)	Built-in or swappable for CD-ROM drive	External
CD-ROM drive	Swappable 10X	Swappable 8X (optional)	Portable 8X
Sound card	16-bit wavetable	16-bit	16-bit
Speakers	Stereo and microphone	One speaker and microphone	Stereo and microphone
Modem	33.6-Kbps telephony	28.8-Kbps	33.6-Kbps PC Card
PC card slots	Two Type II (with CardBus support)	Two Type II	Two Type II
I/O ports	VGA, high-speed serial, parallel, USB, docking station or port replicator, NTSC video (in/out), Zoomed Video	VGA, serial, parallel, docking station or port replicator	VGA, high-speed serial, parallel, USB, docking station or port replicator
Infrared port	Fast (4-Mbps) IR transceiver	Optional 115-Kbps IR transceiver	Fast (4-Mbps) IR transceiver
Security lock slot	Included	Optional	Included
Keyboard and mouse	Full-size and integrated pointing device	Full-size and integrated pointing device	Full-size and integrated pointing device
Operating system	Windows 95 (OSR 2.1)	Windows 95 (OSR 2.1)	Windows 95 (OSR 2.1)
Software bundle	Included	Included	Included
Warranty	3 years	1 year	3 years
Free on-site service	1 year (minimum)	1 year (minimum)	1 year (minimum)
24-hour, 7-day support	Included	Included	Included
Extras	Color video camera with CardBus adapter for mobile videoconferencing	Docking station or port replicator	Docking station or port replicator, second battery
Price	\$8,500	\$3,000	\$4,000

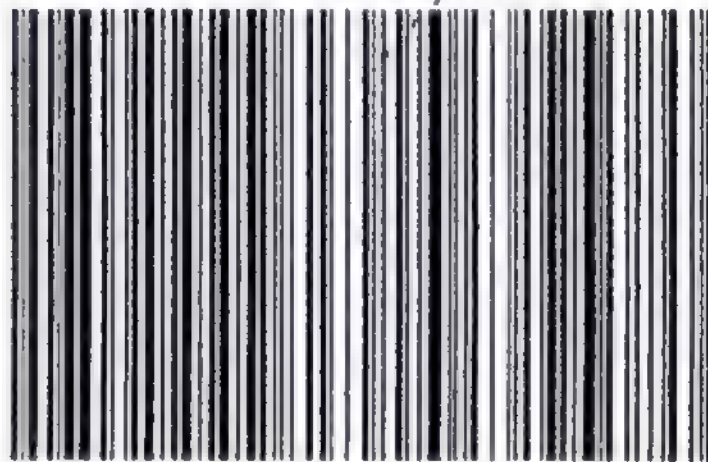
YOUR CANDIDATES:

	NOTEBOOK A	NOTEBOOK B	NOTEBOOK C
Company name			
Notebook model			
Processor			
L2 cache			
System memory			
Hard disk			
System weight			
Screen			
Graphics card memory			
Battery			
Floppy disk drive			
CD-ROM drive			
Sound card			
Speakers			
Modem			
PC card slots			
I/O ports			
Infrared port			
Security lock slot			
Keyboard and mouse			
Operating system			
Software bundle			
Warranty			
On-site service			
24-hour, 7-day support			
Extras			
Price			

1. Follow instructions on the other side

Back

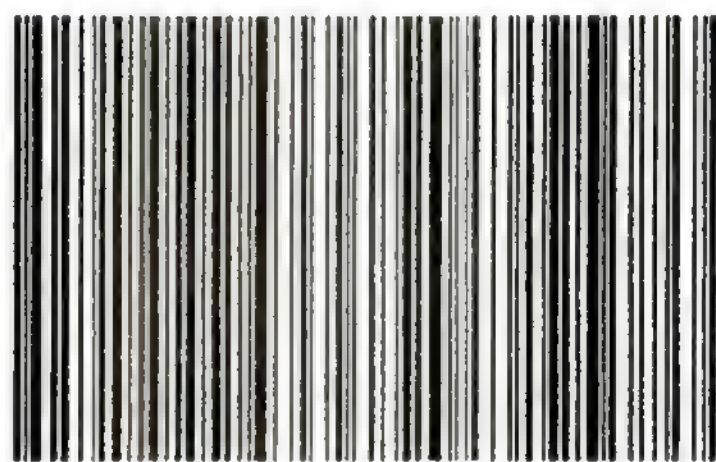
GbslipBack-0018



Inverted Back

1. Follow instructions on the other side

Folded edge of the page



GbsSlipSheet-001

Inverted Foldout slip-sheet

Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
1. Front side touching the free page
2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Buyers' Worksheet: Desktop PCs

FEATURE	THE HOME PC	THE OFFICE PC	THE DREAM MACHINE
Processor	Pentium MMX/233	Pentium MMX/200	Dual Pentium II/300
L2 cache	512K	256K	512K per CPU
System memory	32MB EDO	32MB for Windows 95, 64MB for Windows NT 4.0	128MB EDO ECC
Expansion bus	PCI/ISA with USB (2 connectors)	PCI/ISA with USB (2 connectors)	PCI/ISA with USB (2 connectors)
Hard disk	3.5GB EIDE	2GB EIDE (minimum)	Two 4.5GB Ultra Wide SCSI in a RAID Level 0 array
CD-ROM drive	DVD or 12X/16X	12X/16X	DVD
Sound card	Wavetable audio board	Integrated 16-bit	Wavetable audio board
Speakers	Powered with subwoofer	2-piece or integrated on monitor	Powered with subwoofer
Graphics card memory	4MB with 3-D support	4MB on a PCI graphics card	16MB OpenGL graphics accelerator
Monitor size	17-inch	17-inch	21-inch
Modem	56Kbps	Optional	Cable, ISDN, or DSL modem
Network interface card	Optional (for cable or DSL modems, or for home networking/printer sharing)	Integrated Fast Ethernet	Optional
Floppy disk drive	1.44MB minimum, 120MB optional	1.44MB	120MB
Additional storage/Tape backup	1GB Jaz or 100MB Zip drive (optional)	Optional	4-mm 4GB DAT drive
Power supply	200W	200W	300W
Uninterruptible power supply	Standard, 250VA	Optional	Standard, 250VA
High-speed serial and parallel ports	Standard	Standard	Standard
Infrared ports	Optional	Optional	Fast (4-Mbps) IR
Keyboard and mouse	Standard	Standard	Standard
Operating system	Windows 95 (OSR 2.1)	Windows 95 (OSR 2.1) or NT 4.0	Windows NT Workstation 4.0
Software bundle	Included	Optional	Included
Warranty	3 years	3 years	3 years
On-site service	3 years	1 year (minimum)	3 years
24-hour, 7-day support	Included	Included	Included
Case locks	None	Standard	Standard
Extras	MPEG-2 AC-3 decoder for DVD drive, camera for videoconferencing with office or family	Optional	Dual-channel Ultra Wide SCSI adapter, MPEG-2 AC-3 decoder for DVD drive, camera for videoconferencing, second removable-media device
Price	\$3,500	\$3,000	\$18,000

YOUR CANDIDATES:

	COMPUTER A	COMPUTER B	COMPUTER C
Company name			
PC model			
Processor			
L2 cache			
System memory			
Expansion bus			
Hard disk			
CD-ROM drive			
Sound card			
Speakers			
Graphics card memory			
Monitor size			
Modem			
Network interface card			
Floppy disk drive			
Additional storage/Tape backup			
Power supply			
Uninterruptible power supply			
High-speed serial and parallel ports			
Infrared ports			
Keyboard and mouse			
Operating system			
Software bundle			
Warranty			
On-site service			
24-hour, 7-day support			
Case locks			
Extras			
Price			

How to Contact the Leading Vendors

Below we supply contact information for several companies, many of which were rated in this year's Service and Reliability Survey (page 181). We include the basic service and support policies as well. In some cases, a vendor's warranty differs from line to line, so we indicate a range. At least one year of on-site service is frequently included in a typical parts-and-labor warranty; usually coverage can be extended yearly for an additional charge—though often only through a third party. Most vendors will pay to ship a fixed machine back to you, but you sometimes have to pay to get it to them first.

	Telephone	Web address	Tech-support hours (eastern)	Warranty (years)		Onsite service (1 year)		Money-back policy (direct sales only)
				Desktops	Notebooks	Desktops	Notebooks	
Acer (CA)	800-558-2237, 408-432-6200; fax, 408-922-2933	www.acer.com/sec	24 hours, 7 days	3	1	Included	None	10 days (85% refund within 20 days)
ALR (CA)	800-444-4257, 714-581-6770; fax, 714-581-9240	www.alr.com	9:00-9:00 M-F, 10:00-4:00 Sat.	Parts, 5; labor/peripherals, 3	N/A	\$9.95	N/A	Desktops: None/Notebooks: No direct sales
Apple (CA)	800-538-9696, 408-996-1010	www.apple.com	9:00-9:00 M-F	1	1	Included	None	No direct sales
AST (CA)	800-876-4278, 714-727-4141	www.ast.com	24 hours, 7 days	1-3	1-3	Included	Included	No direct sales
Compaq (TX)	800-345-1518, 281-370-0670; fax, 281-518-1442	www.compaq.com	24 hours, 7 days	1-3	Parts, 1-3; labor, 1	Included	None	30 days
Dell (TX)	800-388-8542, 512-338-4400; fax, 512-728-3653	www.dell.com	24 hours, 7 days	3	Parts, 1-3; labor, 1	Included	Included or up to \$149	30 days
Digital (MA)	800-344-4825, 508-493-5111; fax, 508-493-7374	www.windows.digital.com	8:00-8:00 M-F	Parts, 3; labor, 1	1	Included	None	30 days
DTK (CA)	800-289-2385, 818-810-0098; fax, 818-810-0090	www.dtkcomputer.com	8:30-5:30 M-F	2	1	\$50	None	No direct sales
Everex (CA)	800-383-7391, 510-498-1111; fax, 510-683-2186	www.everex.com	24 hours, 7 days	1-3	2	Included	None	No direct sales
Fujitsu (CA)	800-838-5487, 408-935-6800; fax, 408-935-1789	www.fujitsu-pc.com	24 hours, 7 days	N/A	1-3	N/A	None	No direct sales
Gateway (SD)	800-846-2000, 605-232-2000; fax, 605-232-2023	www.gw2k.com	24 hours, 7 days	3	1	Included	None	30 days
Hewlett-Packard (CA)	800-322-4772	www.hp.com	8:00-8:00 M-F	3	3	Included	None	No direct sales
Hitachi (CA)	800-555-6820, 408-321-5218	www.hitachipc.com	24 hours, 7 days	N/A	1-5	N/A	None	No direct sales
IBM (NY)	800-426-2968, 914-766-1900	www.pc.ibm.com	24 hours, 7 days	3	1-3	Included	None	None
Micron (ID)	888-634-8799, 208-893-3343; fax, 208-893-7985	www.micronpc.com	24 hours, 7 days	Parts, 3-5; labor, 1	Parts, 1-5; labor, 1	Included	None	30 days
MidWest Micro (OH)	800-871-9137, 513-368-2309; fax, 800-562-6622	www.mwmicro.com	9:00-9:00 M-F, 10:00-4:00 Sat.	3-5	N/A	None	N/A	30 days
NEC (CA)	888-306-4636, 508-264-8000; fax, 508-635-4866	www.nec-computers.com	24 hours, 7 days	3	1-3	Included	None	No direct sales
Packard Bell NEC (CA)	800-733-5858	www.packardbell.com	24 hours, 7 days	1	N/A	Included	N/A	No direct sales
Quantex (NJ)	800-780-9001, 908-563-4166; fax, 908-563-0407	www.quantex.com	24 hours, 7 days	Parts, 3; labor, 1	N/A	Included	N/A	30 days
Samsung (NJ)	888-866-8372, 201-229-4000	www.sosimple.com	24 hours, 7 days	N/A	3	N/A	None	No direct sales
Sharp (NJ)	800-237-4277, 201-529-8200; fax, 201-529-9113	www.sharp-usa.com	24 hours, 7 days	N/A	3	N/A	None	90 days
Sony (CA)	800-476-8972	www.sony.com/pc	24 hours, 7 days	1	N/A	Included	N/A	No direct sales
Tangent (CA)	800-800-5550, 415-342-9388; fax, 415-342-9380	www.tangent.com	8:30 A.M.-9:30 P.M. M-F, 1:00 P.M.-8:00 P.M. Sat.	3	N/A	Included	N/A	30 days
Texas Instruments* (CA)	800-531-0616, 408-432-6200; fax, 408-922-2933	www.acer.com/sec	24 hours, 7 days	N/A	1-3	N/A	None	30 days (85% refund)
Toshiba (CA)	800-457-7777	www.computers.toshiba.com	24 hours, 7 days	1-3	1-3	Included (90 days or 1 year)	\$49	No direct sales
Tri-Star (AZ)	800-848-3927, 602-731-4926; fax, 602-731-9010	www.tri-cad.com	9:00-7:30 M-F	Parts, 3; labor, lifetime	N/A	\$49	N/A	30 days
Unisys (CA)	800-874-8647, 408-434-2848; fax, 800-345-9015	www.pc.unisys.com	24 hours, 7 days	3	3	Included (in certain cities)	None	90 days
WinBook (OH)	800-851-4518; fax, 800-448-0308	www.winbook.com	8:00 A.M.-9:00 P.M. M-F, 9:00-4:00 Sat.	N/A	1	N/A	None	30 days
ZDS (MA)	800-261-7926, 508-635-6700; fax, 508-635-6790	www.zdsdirect.com	8:00 A.M.-9:00 P.M. M-F, 9:00-5:00 Sat., Sun.	3	N/A	Included	N/A	30 days

N/A—Not applicable. The vendor does not sell this product line.

* Texas Instruments' notebook division is now owned by Acer.

We've got one



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and one

BAD

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say light is getting jea...
powerful Pentium M...
generation Ultra A...
performance and...
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Gateway Destination™ Big Screen PC/TVs

16-241

- Intel® 266MHz Pentium® II Processor with 512K Cache
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- Destination 31" VGA Color Monitor
- STB® 2MB Graphics Accelerator with Cable-Ready TV Tuner
- 6.4GB 10ms EIDE Hard Drive
- 12X min/16X max CD-ROM & 3.5" Diskette Drives
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- Ensoniq® Wavetable Audio
- ▶ harman/kardon® High-Fidelity Sound System
- TelePath® Modem for Windows with x2™ Technology*
- 7-Bay Charcoal-Colored PC Case
- Wireless Keyboard w/ Integrated EZ Pad® Pointing Device
- Wireless Field Mouse® Remote
- Microsoft® Windows® 95
- Destination Software Collection
- MMX™ Technology-Enhanced Software
- Gateway Gold™ Premium Service & Support for Big Screen PC/TVs

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16-231

- Intel 233MHz Pentium II Processor with 512K Cache
- 32MB EDO DRAM
- Destination 31" VGA Color Monitor
- STB 2MB Graphics Accelerator with Cable-Ready TV Tuner
- 6.4GB 10ms EIDE Hard Drive
- 12X min/16X max CD-ROM & 3.5" Diskette Drives
- Ensoniq Wavetable Audio
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- TelePath Modem for Windows with x2 Technology*
- 7-Bay Charcoal-Colored PC Case
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- Wireless Field Mouse Remote
- MS® Windows 95
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16-166

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- 256K Pipelined Burst Cache
- Destination 31" VGA Monitor
- STB 2MB Graphics Accelerator with Cable-Ready TV Tuner
- 3.2GB 12ms EIDE Hard Drive
- 12X min/16X max CD-ROM & 3.5" Diskette Drives
- Ensoniq Wavetable Audio
- Boston Acoustics® MicroMedia™ 3-Piece High-Fidelity Speaker System
- TelePath Modem for Windows with x2 Technology*
- 7-Bay Charcoal-Colored PC Case
- Wireless Keyboard w/ Integrated EZ Pad Pointing Device
- Wireless Field Mouse Remote
- MS Windows 95
- Destination Software Collection
- MMX Technology-Enhanced Software
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- E™/GX 4MB, 3-D 64-Bit PCI Graphics
- Ultra Wide SCSI-2 Hard Drive
- 12X min/16X max CD-ROM & 3.5" Diskette Drives
- 1GB Tape Backup Drive
- Wavetable Audio
- High-Fidelity 3-Piece Speakers
- TelePath Modem for Windows with x2 Technology*
- MS IntelliMouse™
- MS Office 97,
- on plus Encarta® 97
- Enhanced Software
- in Service & Support

\$174/mo.

Maximum data transfer rate dependent on certain variables, including particular modems with which you are communicating, telephone lines, communications software and communications protocols.

The Destination 31-inch color monitor is covered by a one-year limited warranty. Write or call for a free copy.



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www.gateway.com

610 Gateway Drive, P.O. Box 2000 • North Sioux City, S.D. 57049-2000
Phone 605-232-2000 • Fax 605-232-2023

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Perfect Desktops

THE HOME OFFICE

As the nerve center of your own business or the place you go at night to catch up on work that you couldn't do during the day, the home office is a vital place. So don't shortchange it in terms of computer and telephony equipment, office supplies, furniture, and lighting. ☞ Look at the room beyond the computer. You should have a desk with enough space to spread out, a chair that not only is comfortable but provides adequate lumbar support, and ample lighting. In place of some peripherals listed to the right, you may consider a multifunctional device that combines an ink jet color or monochrome laser printer with plain-paper faxing and convenience copying. And don't forget the plants: They'll brighten up the room and give you something to talk to on those late nights after the kids have gone to bed. —Carol Venezia

The PC For your home-office PC, we'd suggest starting with a Pentium-class processor with MMX; for more details, refer to our Home PC configuration.

ISDN Modem If your local telephone company provides ISDN service, get it: It's well worth the price. Even if analog modems are almost as fast, ISDN connects in a few seconds versus 45 to 90 seconds for POTS modems.

Video Camera For videoconferencing with your office or with clients, you'll need a camera.

Other equipment that you'll need in your home office includes a plain-paper **fax machine**; a personal **copier** (\$500 to \$1,000); and a digital **answering machine**. We also suggest that you purchase a **flatbed color scanner** (about \$400 and up) to archive important documents, and a four-color **ink jet printer** for flexible document output.



Perfect Desktops

THE PC TV

Convergence. It may sound like just another buzzword, but it's not: It's quickly becoming reality. Your entertainment center—and in time, your entire home—will become a computer-centric operation. So why not start now? 🐸 The key elements of a great “home theater” system are the PC, the monitor, and the speaker system. Depending on the quality of system you buy, you could spend upwards of \$10,000. Or, for about \$3,500 to \$5,000, there is Gateway's Destination Big Screen PC/TV, which uses a 31-inch VGA monitor, or Compaq's PC Theatre, which uses a 36-inch display. The tuner used in these systems may not quite reach TV quality, but it's very close. In either case, you should do your homework first: Decide how much you can spend, then shop around. Your entertainment center will serve your entire family, and it deserves the same amount of time and attention that you devoted to poring over fabric swatches for the couch. —Carol Venezia

PC with TV Tuner The computer that powers your PC TV system should be configured with at least a 200-MHz MMX processor, 32MB of RAM, a 3GB hard disk, a graphics board with a cable-ready TV tuner, a 16X CD-ROM drive or a DVD drive, a wavetable sound card, and a wireless keyboard and mouse.

TV The monitor for your PC TV system should have at least a 31-inch tube that supports VGA resolutions. Higher-resolution monitors generally are not available for less than \$5,000.

Speaker System To make the most of your PC TV experience, you need great sound. We suggest purchasing a surround-sound system, which requires at least five speakers (front left, right, and center, and typically rear left and right).

Remote Control If your house is like most, the remote is probably hiding inside the family-room sofa.



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Good news for consumers! A smart new company called **Unicent**—with seven solid years of making, selling and servicing computers for the home, school and business—has just come to the table, with newly released Pentium II Technology, leading-edge peripherals, sophisticated support and competitive prices—all as good as or better than the other guys. But—we offer you something more—a philosophy of doing business that comes with every product we sell.

We will sincerely strive to make your relationship with your **Unicent** computer the very best it can possibly be—from the moment you lift it from the box...

- It will be easy to set up, easy to understand, easy to use.
- It will come with the **latest technology and leading-edge systems** for its class.
- It will be designed with **built-in investment protection**, allowing you to change and grow with your computer.
- It will give you one of the **best guarantees in the business**.

Your **Unicent** computer will work so well and so reliable that you should never need service. But if you do, we will be here to support you 24 hours a day, 7 days a week, with the finest technical back-up you could hope for.

We pledge this to you, not only because we believe that trust and partnership are simply good business, both for today and for a lifetime, but also because it's the way we ourselves would like to be treated.

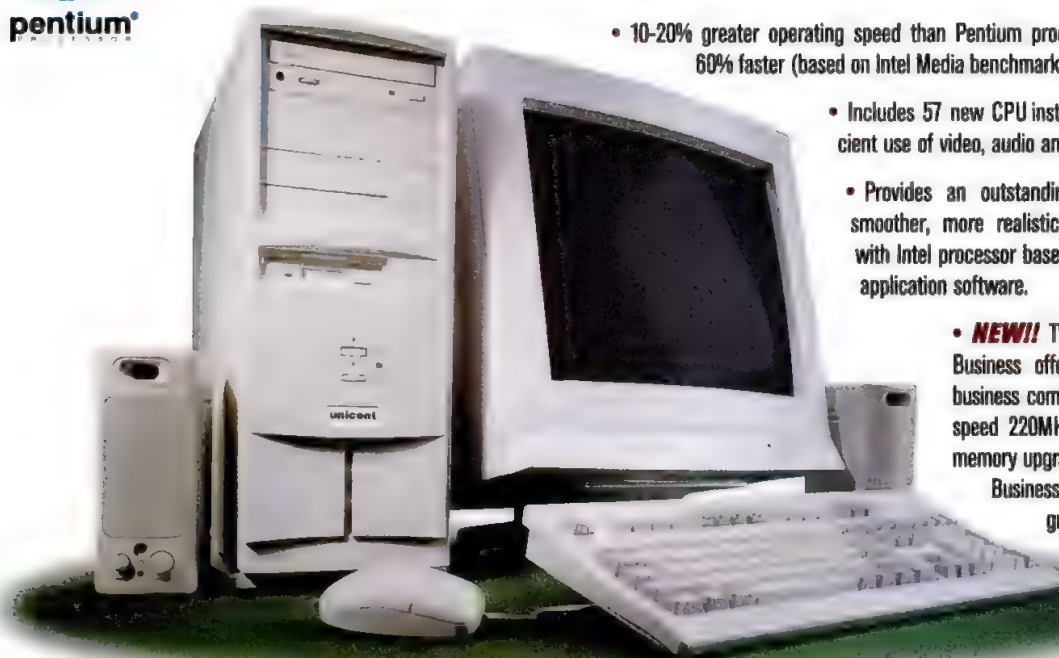
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Perfect Desktop Components

PROCESSOR



he abundance of processors currently available for desktop PCs is certainly exciting but definitely confusing as well. Now more than ever, it pays to do your homework before you go PC shopping. ☞ Intel now offers four distinct CPU families: the classic Pentium

(pretty much relegated to the low end, with speeds topping out at 200 MHz); the Pentium with MMX Technology (great for consumer machines and low-cost but leading-edge business machines, with speeds up to 233 MHz); the Pentium Pro (mainly for servers and high-end multiprocessor workstations, having speeds up to 200 MHz with 512K of integrated L2 cache); and the new Pentium II (for high-powered desktops and workstations, with speeds up to 300 MHz).

☞ AMD and Cyrix also have much to offer. AMD's K6 processor is fairly new to the market, reaches speeds of 233 MHz (with 266 MHz reportedly right around the corner), and presents a serious challenge to Intel's high-speed Pentiums and Pentium IIs. ☞ By the time you read this, Cyrix should be shipping its 6x86MX (better known by its code name, M2); the vendor recently began shipping its MediaGX processor, a low-cost chip that integrates graphics, audio, the PCI interface, and the memory controller to lower costs. Cyrix gives its 6x86 processors a "PR" (performance rating) designation, which indicates performance as compared with a Pentium CPU, based on ZD Winstone. For example, a Cyrix 6x86-133 gets a "PR166" rating, which means that on our Winstone tests, it performs on a par with a 166-MHz Pentium.—Carol Venezia

CPU Speeds and Feeds

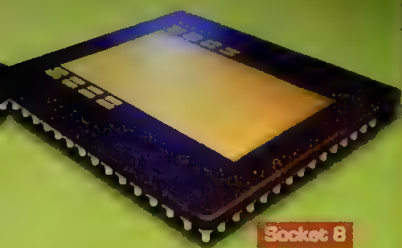
Chip name	Speed (MHz)	L1 cache and design	Internal voltage/ external wattage
Pentium (classic)	75, 90, 100, 120, 133, 150, 166, 200	8K data, 8K instruction, write-back, 2-way set-associative	3.3V, 3.0W
Pentium (mobile)	75, 90, 100, 120, 133, 150, 166	8K data, 8K instruction, write-back, 2-way set-associative	2.9V, 8.6W
Pentium II	233, 266, 300	16K data, 16K instruction, write-back, 4-way set-associative	2.8V, 38.2W
Pentium Pro	150, 166, 180, 200	8K data, 8K instruction, write-back, 4-way set-associative	3.3V, 37.9W (maximum)
Pentium MMX	150, 166, 200, 233	16K data, 16K instruction, write-back, 4-way set-associative	2.8V, 14.1W
Pentium MMX (mobile)	150, 166	16K data, 16K instruction, write-back, 4-way set-associative	2.45V, 7.7W
AMD K6	166, 200, 233	32K data, 32K instruction, 2-way set-associative, write-back policy	3.2V, 28W
Cyrix 6x86	133 (PR166), 150 (PR200)	16K unified write-back cache, fully associative 256-byte instruction line cache	Varies; typically 2.8V core, 3.3V I/O, 14W (PR200)
Cyrix 6x86MX	150 (PR166), 166 (PR200), 188 (PR233)	64K unified 4-way set-associative write-back cache, fully associative 256-byte instruction line cache	Varies; typically 2.8V core, 3.3V I/O, 12.4W (PR233)
Cyrix MediaGX	133, 150, 180	16K unified write-back cache, 4-way set-associative	2.9V, 4.2W



Socket 7 Used for fifth-generation CPUs from Intel, Cyrix, and AMD (including the Pentium, 5x86, 6x86, K5, and K6).

Socket 8 Used by Intel for its original Pentium Pro; not likely to be used by any other chip or CPU manufacturer.

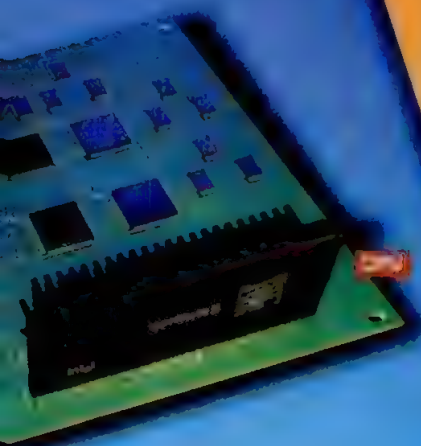
Slot 1 A new packaging concept developed by Intel for Pentium II processors. The CPU, L2 cache, and TagRAM are mounted on a small printed circuit board inside a metal casing. The entire package fits into a slot with an edge connector.



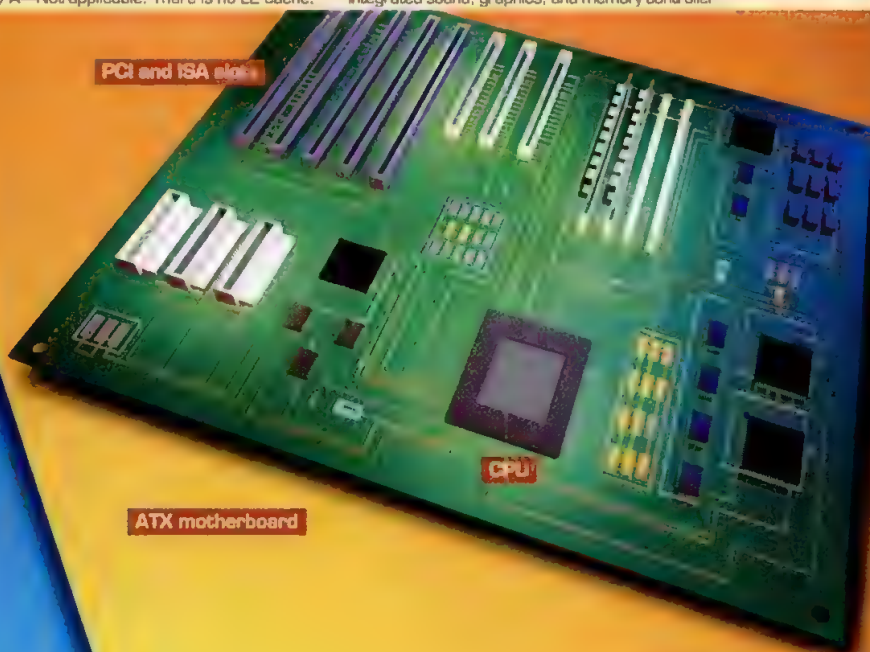
Socket 8



Slot 1



NLX motherboard



PCI and ISA slots

ATX motherboard

CPU

CPU Features Comparison

Chip name	Bus speed to cache (MHz)	Special extensions	Process technology	Packaging
Pentium [classic]	60, 66	None	0.35 μ , BiCMOS	PGA
Pentium [mobile]	66	None	0.35 μ , BiCMOS	Tape carrier
Pentium II	Half of CPU speed	MMX	0.35 μ , CMOS	SEC cartridge
Pentium Pro	Matches CPU speed	None	0.35 μ , BiCMOS	DC PGA
Pentium MMX	60, 66	MMX	0.35 μ , CMOS	PGA
Pentium MMX (mobile)	60, 66	MMX	0.35 μ , CMOS	Tape carrier
AMD K6	66	Licensed MMX	0.35 μ , CMOS	PGA
Cyrix 6x86	66 (PR166), 75 (PR200)	None	0.35 μ , CMOS	296-pin SPGA, Socket 7-compatible
Cyrix 6x86MX	60 (PR166), 66 (PR200), 75 (PR233)	MMX	0.35 μ , CMOS	296-pin SPGA, Socket 7-compatible
Cyrix MediaGX	N/A	MediaGX*	0.35 μ , CMOS	BGA

N/A—Not applicable: There is no L2 cache. * Integrated sound, graphics, and memory controller

NLX Motherboard A new motherboard form-factor specification for low-profile systems. The design of the board allows better access to upgradeable components, purportedly to lower maintenance costs.

CPU NLX boards will accept all current and planned generations of processors (we show Slot 1 here, but the motherboard will take socketed CPUs as well).

Dockable Motherboard The NLX board itself is dockable within the system housing, so it can be removed

for maintenance and replaced easily.

Expansion Slots All PCI and ISA slots on an NLX board are on a riser card that plugs into the dockable motherboard. This configuration allows for low-profile designs.

ATX Motherboard The ATX form-factor motherboard has been in use for about a year, the follow-on to the Baby AT. Manufacturers have relocated the processor, reoriented the power supply, and rotated the board 90 degrees (as compared with the Baby

AT), so the ATX board can accept full-length expansion cards. SIMM connectors can be moved away from slots and bays, and CPU upgrades can be performed without removing installed cards.

CPU ATX boards will accept all types of processors, including new Slot 1 devices.

PCI and ISA Slots Because the ATX board is physically larger than the NLX design, expansion slots are floor-mounted.

Perfect Desktop Components

GRAPHICS

Most systems now come with 15-inch displays, but if you are buying today, we recommend a 17-inch model. A good 17-inch display for business or personal use can be had for \$650; a higher-end, professional model for desktop publishing and Web design costs around \$900. CAD and graphics professionals will need the screen real estate and resolution choices of a good 20- or 21-inch model (\$1,200 to \$1,800). A given monitor is about as deep as its screen diagonal; even if you can afford a 21-inch monitor, you may not be able to fit it on your desk. For power users whose companies are tight with the purse strings, the emerging class of 19-inch monitors (many less than \$1,000) offers promise, providing 28 percent more viewing area than 17-inch models. 🐸 Another emerging trend is the availability of USB (Universal Serial Bus) hub options for some monitors. These hubs connect to the USB ports on newer PCs and, with proper driver and OS support (found in Microsoft Windows 95 Version OSR 2.1, and to be included in the next release of Windows), make it easy to connect USB-compliant peripherals to your monitor. Look for USB mice, keyboards, page scanners, digital cameras, and more to begin surfacing in the second half of this year. 🐸 For the graphics accelerator, insist on at least 4MB of RAM (which permits 24-bit color at 1,024-by-768 resolution), 2-D and 3-D Windows acceleration, and PCI-bus connectivity. The more RAM, the higher the resolution and color depth (number of colors) the board will support. The board also needs more RAM to deliver sizable texture-memory support and other 3-D features for 3-D games and business titles. Look for extra touches such as a built-in NTSC-out scan converter (so you can use a television set as a monitor) and a feature connector (for add-on daughterboards such as TV tuners or video-capture solutions). —*Jamie M. Bsals*

Specifying Graphics RAM

The amount of RAM you need on your graphics card depends on the resolution and color depth (the number of colors) you plan to run. We recommend at least 4MB of graphics RAM for a typical business or home PC accelerator.

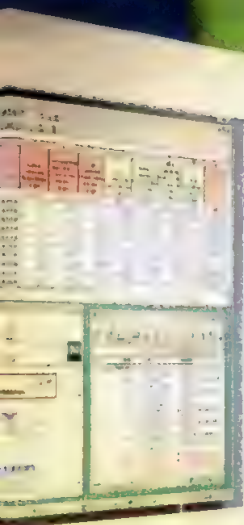
Graphics professionals will want at least 8MB. The figures below are the minimum RAM required for each resolution and color depth.

Resolution	16-color (4-bit)	256-color (8-bit)	65,000-color (high color, or 18-bit)	16.7 million -color (true color, or 24-bit)
640 x 480	0.5MB	0.5MB	1MB	2MB
800 x 600	0.5MB	1MB	2MB	2MB
1,024 x 768	1MB	1MB	2MB	4MB
1,280 x 1,024	1MB	2MB	4MB	4MB
1,600 x 1,200	2MB	2MB	4MB	8MB
1,800 x 1,440	2MB	4MB	8MB	8MB



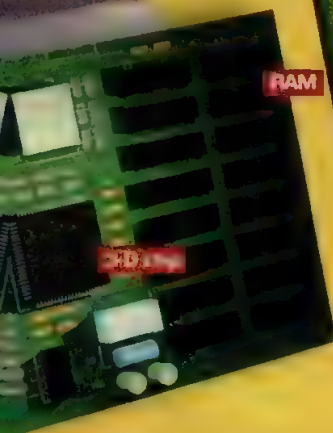
17-Inch Screen Size Business users should opt for a 17-inch display (\$650 to \$950), or a 19-inch unit (less than \$1,000) if budget permits. Graphics and CAD users will want a 20- or 21-inch CRT.

0.25- to 0.28-mm Mask Pitch A finer mask pitch (the horizontal distance between phosphor dots or stripes of the same color) will translate into a sharper image. In a 17-inch model, look for a dot pitch of 0.28 mm or less for an Invar shadow mask CRT, or 0.25-mm pitch or less for an aperture grille tube.



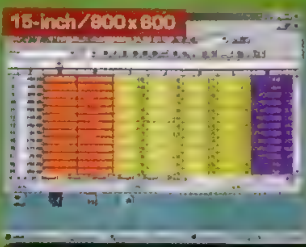
Mask pitch

USB hub

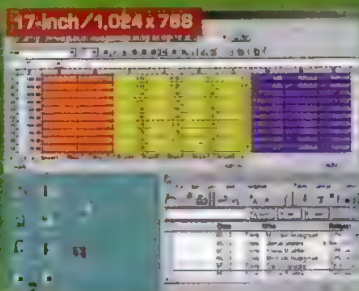


RAM

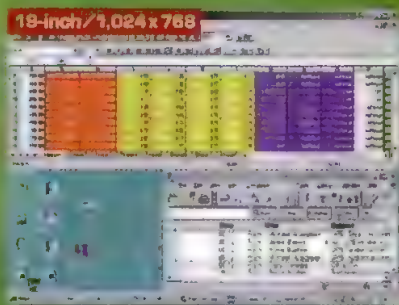
Add-ons



15-inch/800x600



17-inch/1,024x768



19-inch/1,024x768



21-inch/1,280x1,024

Recommended Resolutions

The higher your screen resolution, the more data or active windows you can see on-screen at once, which means less toggling and scrolling. But try to work at too high a resolution and you won't be able to read text. This chart shows the popular monitor sizes and resolution modes. Resolutions not listed are not available on most monitors at an acceptable refresh rate.

15-inch	17-inch	19-inch	21-inch
640 x 480	640 x 480	640 x 480	640 x 480
800 x 600	800 x 600	800 x 600	800 x 600
1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768
	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024
		1,600 x 1,200	1,600 x 1,200
		1,800 x 1,440	1,800 x 1,440

• Not recommended • Acceptable • Recommended

85-Hz Refresh The vertical refresh rate is the number of times per second the screen is redrawn. A refresh rate of 85 Hz or better at your chosen resolution ensures a stable, comfortable, flicker-free image. Most midrange 17-inch models now deliver 1,024-by-768 resolution at 85 Hz.

Controls and Speakers Beyond the basics of brightness and contrast, look for controls to correct pincushioning, convergence, and color attributes. Business users who need basic PC

audio might consider built-in speakers, which add about \$50 to the price.

USB Hub Consider a monitor that offers a USB hub option (\$100 to \$150). The hub, which connects to the USB port on a newer PC, will let you connect up to four USB peripherals.

4MB of RAM Buy a card with at least 4MB of RAM. Graphics users should specify 8MB.

3-D Chip A 3-D-enabled chip set ensures that you can use the card with

many of the currently available 3-D game titles and the coming wave of business applications.

TV Out A built-in NTSC converter will let you hook a standard television to your computer for presentations or big-screen gaming.

Add-Ons Check that the board has a feature connector, and that the maker (or a third party) offers add-on options such as a TV tuner or video-capture daughterboard.

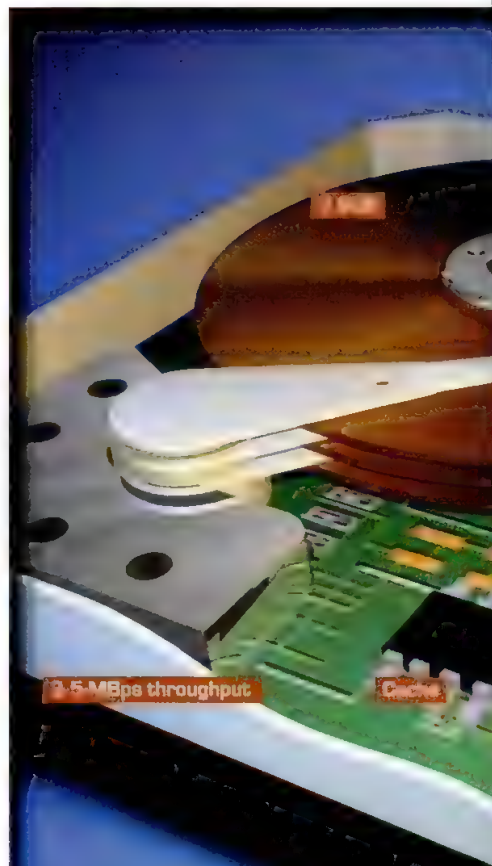
Perfect Desktop Components

STORAGE

The capacity sweet spot for a new hard disk is 3GB to 3.6GB (\$350 to \$400), which should give you sufficient room for growth over the next 18 months. Beyond capacity, a drive's minimum *sustained data rate* is the most important spec to look for. A data rate of 3.5 MBps (megabytes per second) should prove adequate for most desktop PC applications. Multimedia developers should look for a higher-performance drive with a rate of about 5 MBps. Be careful not to confuse the sustained data rate with the drive's *burst data rate* (20 MBps to 33 MBps), which indicates how quickly cached data can move from the drive's RAM across the interface bus. A better drive will also have an intelligent on-board cache to buffer and manage recently accessed data based on access patterns, compared with a simple buffer that simply stores recently accessed data and overwrites that data regardless of access patterns. For a business PC, an EIDE hard disk is fast enough for today's operating environments and will cost \$200 less than a SCSI drive. For higher-end workstations and multimedia developers, the better performance and intelligent prioritization of read/write requests that SCSI delivers are worth the extra investment.—*Jamie M. Bsates*

External I/O Interfaces at a Glance

Interface	Burst throughput	Uses and comments
EIDE (Fast ATA)/ATAPI	11–16.8 MBps	Hard disks; CD-ROM, DVD, and tape drives. Adequate performance for a typical mainstream user; less expensive than SCSI.
Fast SCSI (SCSI-2)	10 MBps	High-performance hard disks, CD-ROM and CD-R drives, and color flatbed scanners. Able to off-load I/O processing tasks from CPU, and intelligently order and simultaneously handle I/O requests.
Fast/Wide SCSI	20 MBps	Servers, workstations, performance desktops, RAID subsystems. 16-bit data path provides twice the bus bandwidth of Fast SCSI.
Ultra SCSI (SCSI-3)	20 MBps	Servers, workstations, multitasking desktops, RAID subsystems. Current maximum bus bandwidth for 8-bit SCSI.
Wide Ultra SCSI	40 MBps	Servers, workstations, multitasking desktops, RAID subsystems. Current maximum bus bandwidth for 16-bit SCSI.
Ultra-2 SCSI	40 MBps	Under development: servers, workstations, multitasking desktops, RAID subsystems. Products arriving 1998.
Wide Ultra-2 SCSI	80 MBps	Under development: servers, workstations, multitasking desktops, RAID subsystems. Products arriving 1998.
Ultra-3 SCSI	More than 80 MBps	Under development: servers, workstations, multitasking desktops, RAID subsystems. Products arriving in 3 years.
Wide Ultra-3 SCSI	160 MBps minimum	Under development: servers, workstations, multitasking desktops, and RAID subsystems. Products arriving in 3 years.
IEEE 1394 (FireWire)	100–400 Mbps	Video cameras, CD-ROM and DVD-ROM drives, color scanners, color printers. Could take from SCSI's share or high-bandwidth applications. Products arriving this year.
IEEE 1394B	Up to 1.6 Gbps	Under development as a replacement for EIDE hard disks. Products still 2 to 3 years away.
USB	12 Mbps	Mice, keyboards, and other input devices; page scanners; digital cameras. Hubs and devices beginning to appear.



HARD DISK

A capacity of 3GB to 3.6GB (\$350 to \$400) should cover the needs of a typical PC user. Look for a 5,400-rpm drive with a minimum sustained data rate of at least 3.5 MBps (a multimedia workstation needs a 7,200-rpm drive with throughput of 5 MBps or better). An intelligent 512K cache will improve the efficiency of the drive. An EIDE interface is fine for most desktops; power users will want SCSI.

REMOVABLE DRIVES

Iomega Zip The popularity and portability of this 100MB drive make it easy to share Zip disks with others or take the drive with you on the road. (Drive: \$150. Media: \$14.)

SyQuest EZFlyer Better performance and more capacity (230MB) than the Zip but not as popular. (Drive: \$230. Media: \$30.)

Iomega Jaz Near-hard-disk performance and 1GB capacity for applications and their files. (Drive: \$300. Media: \$125.)



SyQuest SyJet Even better performance and more capacity (1.5GB). The perfect hard disk complement. (Drive: \$400. Media: \$125.)

3.5-Inch Magneto-Optical A capacity of 230MB is good for large files such as video clips. Some drives are portable. (Drive: \$360. Media: \$10.)

PD/CD A combination phase-change writer (650MB) and CD-ROM reader (4X now, 6X soon) is good for near-line storage or backing up hard disks a partition at a time. (Drive: \$600. Media: \$30.)

Compact Disk-Recordable CD-R drives let you make 650MB CD-ROM disks that can be distributed to and used by just about every PC user. (CD-R drive: \$500. Media: \$7.) The new CD-Rewritable drives let you reuse the media. (CD-RW drive: \$600. Media: \$25.)

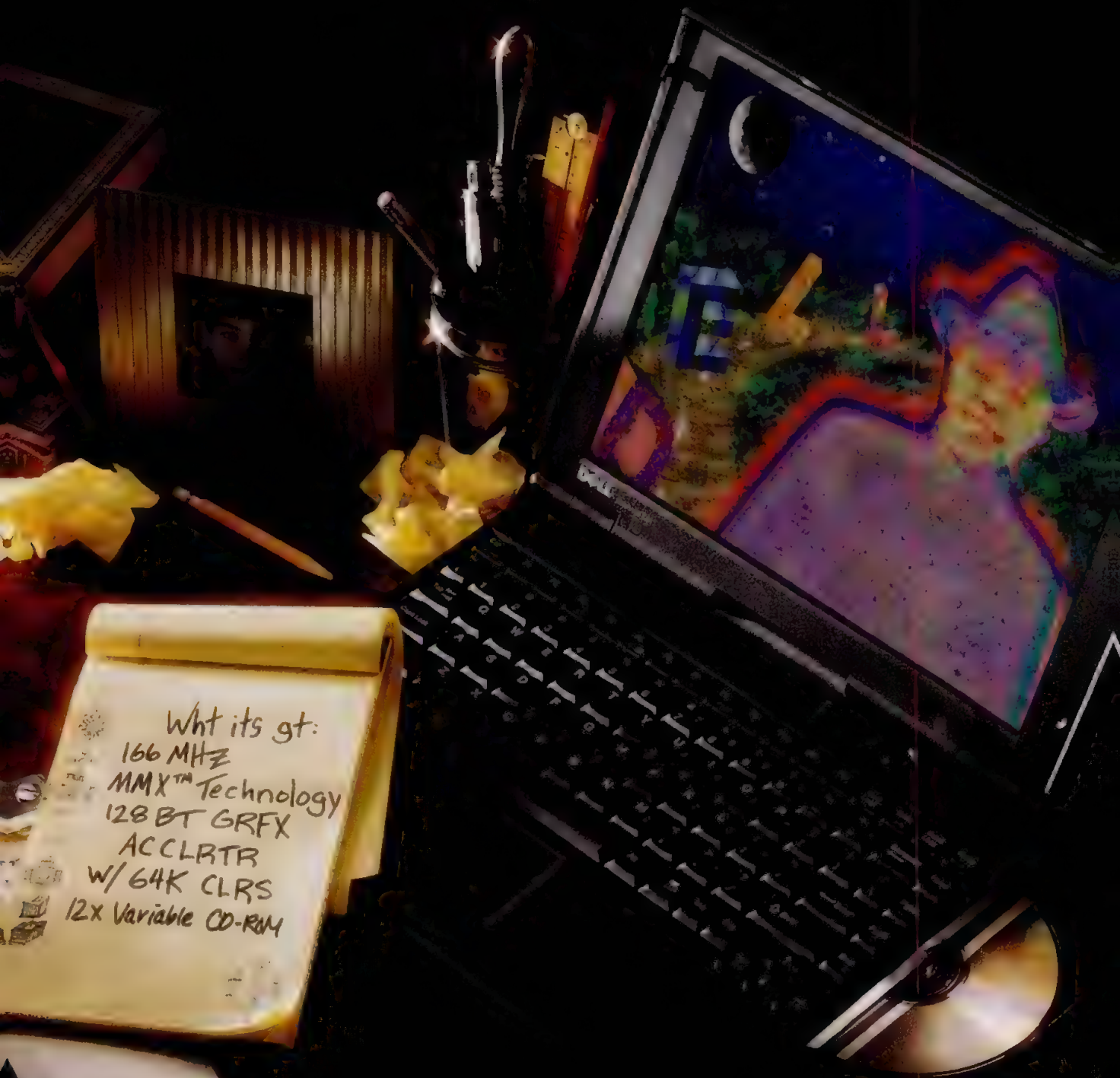
5.25-Inch Magneto-Optical Great for long-term, near-line storage of image files and other critical data. Industry-standard drives fit 2.6GB per cartridge (1.3GB per side); Pinnacle's proprietary Apex pushes that to 4.6GB (2.3GB per

side). (Drive: \$1,800 to \$2,000. Media: \$90 to \$170.)

Tape A range of choices for personal and network backup, from 800MB desktop drives to 8GB server solutions. Tape is slower and less versatile than other types of drives but has a much lower cost per megabyte. (Drives: \$200 to \$1,000. Media: \$10 to \$40.)

LS-120 An alternative to a floppy disk drive, this drive reads standard floppy disks and can write to proprietary 120MB disks. (Drive: \$190. Media: \$12.)

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- PCI Bus with NEW 128-bit Graphics Accelerator with 64K Colors
- Integrated 16-bit Stereo Sound
- Smart Lithium Ion Battery
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- 2.1GB Hard Drive
- Options Bay accepts 12X Variable CD-ROM, 3.5" Floppy Drive (both included) or Optional 2nd Li-Ion Battery
- PCI Bus with NEW 128-bit Graphics Accelerator with 64K Colors
- Integrated 16-bit Stereo Sound
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- Integrated 16-bit Stereo Sound
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Just how fast is the new Dell Latitude LM M166ST? Well, words practically fail us. Let's just say it puts some of the fastest features available right smack in your lap. First there's the 166MHz Mobile Pentium® processor with MMX™ technology. You've never seen multimedia run so swiftly in a notebook. Next, there's the 12X Variable CD-ROM drive. Quick? So quick it's already answered the question. And finally, may we present the Latitude LM system's new NeoMagic 2093 enhanced 128-bit Graphics Accelerator. In plain English, that means faster and better color resolution, and an almost desktop-like 64,000 colors. Whether you're giving presentations on the road, or just trying to get stuff done, this notebook will leave you speechless. To prove it, give us a call, tell us what you need, and we'll build and deliver it as soon as possible. Or, in the language of the Latitude LM... ASAP.

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Perfect Desktop Components

MULTIMEDIA

It's going to be a DVD holiday season in both the PC and home-entertainment markets. The 4.7GB drive adds about \$500 to the cost of a new PC; aftermarket DVD upgrade kits cost \$500 to \$800. This gives you access to the coming wave of data- and video-intensive titles (encyclopedias, mapping programs, databases), interactive games, and movie titles that will also play in home DVD players (\$500) that connect to your TV. DVD drives also play standard audio CDs and CD-ROM disks (at 8X speed). An add-in card decodes the MPEG-2 video and Dolby Digital (AC-3) audio. 🎧 CD-ROM drives still have several years before DVD drives supplant them. Look for a 12X or 16X drive (\$300). The faster rated throughput—1.8 MBps (megabytes per second) to 2.4 MBps—translates into faster performance for loading software or searching databases on CDs. A SCSI interface also boosts performance over a less expensive EIDE solution and puts less strain on CPU resources. For many users, EIDE is good enough; if you will be using your CD-ROM drive in conjunction with a compact disk-recordable drive, however, we recommend a SCSI CD-ROM drive. 🎧 Your sound card should deliver wavetable synthesis for more realistic sound effects and music in multimedia titles. Better sound cards now augment wavetable samples with WaveGuide synthesis for even more true-to-life sound. Card makers are also introducing PCI-based audio solutions (rather than ISA cards). The higher-bandwidth PCI bus allows sound cards to handle simultaneous tasks. —*Jamie M. Bsales*

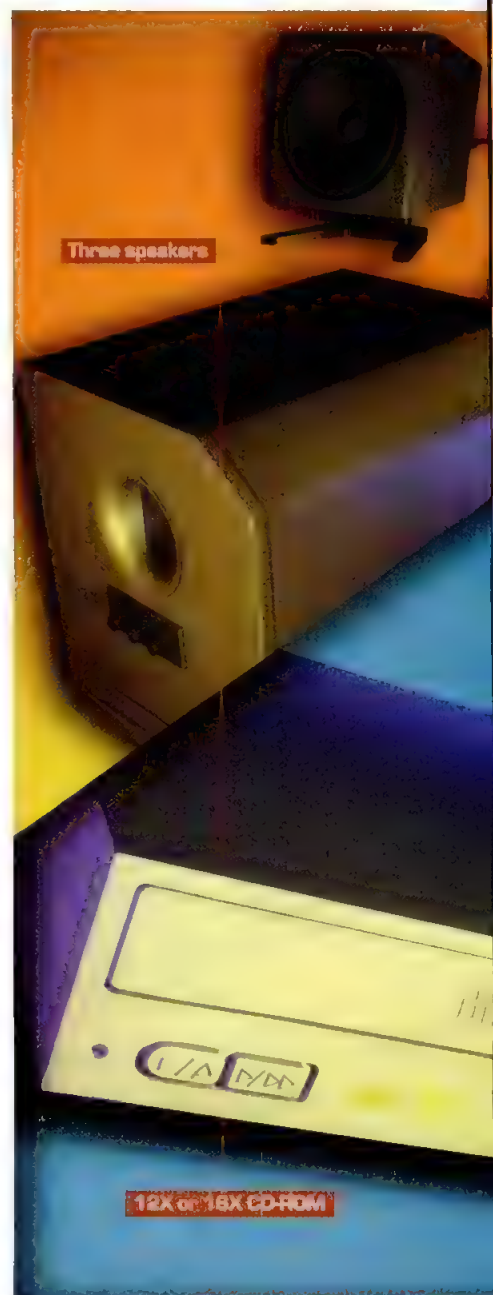
CAV and CLV Most CD-ROM drives are CLV (constant linear velocity) types, where the spindle motor varies its speed to keep the amount of data passing over the laser constant. CAV (constant angular velocity) drives spin the disk at a constant rate, though it means the amount of data passing over the laser is less on the inner tracks (where most CD-ROMs have their information) and greater on the outer tracks. A faster CD-ROM drive will utilize both.

DOLBY DIGITAL (AC-3 or Dolby Digital 5.1). A standard for high-quality audio being used for consumer audio based around DVD players and PCs. It delivers five surround-sound tracks (front left, right, and center and rear left and right) and a subwoofer channel.

MPEG-2 (for Motion Pictures Experts Group). A video compression standard used for DVD and DSS systems. It allows for massive compression of video, so a 2-hour movie fits into several gigabytes—not hundreds of gigabytes. MPEG-2 identifies which portions of a video segment have changed from frame to frame and stores only the data describing the differences.

WAVEGUIDE A sound synthesis technique that recreates a sound based on stored knowledge of the intended instrument characteristics. Also called physical modeling.

WAVETABLE Better than the artificial FM synthesis, wavetable synthesis calls recorded samples of actual instruments from memory as needed.



4.7GB DVD drive These \$500 to \$800 drives play DVD disks, which hold up to 4.7GB of data (such as video) and also play CD-ROMs and audio CDs.

MPEG-2 and Dolby Digital An add-on card decodes the MPEG-2 video and six-channel Dolby Digital audio streaming from the DVD disk.

12X or 16X CD-ROM A fast CD-ROM drive (\$300) will load applications and database information quickly. Look for handy track-skip buttons for audio CD playback.



2MB Wavetable Sound Wavetable samples on your sound card will deliver more realistic music and sound effects in multimedia titles and games, because they are digitized samples of actual instrument sounds. Look for at least 2MB of stored samples.

WaveGuide Instrument sounds are even more lifelike when generated through WaveGuide synthesis, where instrumental sounds are recreated based on stored knowledge of the physical attributes of an instrument.

The physical modeling for all instruments is not yet completed, so sound card makers augment WaveGuide synthesis with wavetable samples.

PCI Audio The newest sound cards employ the PCI bus to handle several audio tasks simultaneously. Moving to PCI also primes PC makers to do away with the ISA bus in a year or two.

Three Speakers Two satellite speakers and a subwoofer delivering 30 watts of power total (\$150 to \$200) are the right combination for a home system,

where games and music will be the norm. For typical business audio—videoconferencing, CD-ROM titles with sound—two speakers with 5 watts per channel will suffice (\$50). They can even be integrated in your monitor or keyboard to save space.

Volume Control A discrete volume control between your sound board and speakers (or a master control on one of the satellites) gives you faster access than using the Windows volume-control applet.

Perfect Portables

THE DREAM NOTEBOOK

For the mobile presenters, the desktop replacers, and the just-gotta-have-its, we present our high-end notebook. One look at the configuration below and you'll see that today's high-end notebook offers a no-compromise solution for mobile computing. In fact, just about every component inside this box rivals that of the desktop, as long as you don't want a Pentium II or Pentium Pro (that comes next year). The only laggard is the graphics subsystem: You still won't find a notebook today with more than 2MB of graphics memory (although we expect this to change by year's end). Where this system doesn't lag, however, is in the connectivity department. The high-end notebook has ports galore, including (left to right, below) an integrated 33.6-Kbps telephony modem, fast (4-Mbps) infrared port, external VGA port, serial port, docking station port, parallel port, keyboard/mouse port, security slot, NTSC video-in/out, and two USB ports.  This notebook comes with just two catches: weight and price. For a portable of this caliber, you'll be hard-pressed to find one that doesn't weigh well in excess of 8 pounds (including all cabling, swappable devices, and transformer). This may not seem like a lot, but wait until you have to lug it between gates in an airport. You'll also find that this machine is quite expensive: Expect to pay between \$6,000 and \$7,000 (or about the price of three comparably equipped desktops). —Carol Venezia

166-MHz MOBILE PENTIUM CPU WITH MMX Some high-end notebooks are available with 200-MHz processors, but they're using the desktop (ceramic-package) version of the chip. We suggest sticking with low-voltage, tape-carrier-package CPUs to conserve battery life.

32MB OF RAM, 256K OF L2 CACHE The latter feature is a must to get the most out of this notebook's high-speed processor.

MICROSOFT WINDOWS 95, OSR 2.1 Many corporations are demanding Windows NT support on notebooks, but we don't recommend it. Windows NT is not meant to be a mobile operating system; it knows virtually nothing about power management, hot docking, and Plug and Play, all

of which are vital components in a notebook (although some vendors use third-party tweaks successfully).

64-BIT PCI GRAPHICS WITH 2MB OF VRAM Notebooks with 4MB of graphics memory for displaying images at higher color depths are on the horizon.

3GB HARD DISK Notebook-size hard disks (usually 17-mm or 19-mm devices) are not nearly as cheap or easily replaceable as desktop drives. We suggest getting the largest disk available for your notebook.

ZOOMED PORT VIDEO, CARDBUS SUPPORT There aren't many ZPV or CardBus devices available now, but as with USB, there will be; make sure that your notebook is ready for them.



13.3-Inch XGA TFT Display This panel supports a resolution of 1,024 by 768 pixels.

Speakers and Microphone The high-end notebook should have stereo speakers for top-quality sound (through the notebook's internal wavetable audio) and a full-duplex microphone, so you can use your notebook as a speakerphone when you're on the road.

Full-Size Keyboard, Integrated Pointing Device Most high-end notebooks now have 19-mm key-



boards; the most popular mouse replacements are pointing sticks and touch pads.

Two Type II PC Card Slots A must for any notebook, the PC Card slots for the high-end notebook should support the CardBus spec as well.

Device Bay Called an *options bay* by some vendors, this housing supports—depending on the notebook—a CD-ROM drive (up to 10X on some models), a floppy disk drive, or a spare battery. Some vendors also offer Zip or

magneto-optical drives as options.

Portable Color Video Camera with CardBus Adapter For mobile video-conferencing, a camera is an obvious must.

Lithium Ion Battery Don't settle for nickel hydride here; all of these components will need the power of lithium.

Multimedia Controls Look for a system with a volume-control thumb-wheel, line-in/out jacks, and speaker and microphone jacks.

Technologies to Watch

On the horizon in the high-end notebook category are 14-inch active-matrix displays (expect these by early fall), notebooks with 4MB of graphics RAM (which is necessary for true-color graphics at 1,024-by-768 resolution), and faster low-voltage CPUs with MMX (200 MHz is rumored to be next up from Intel, the so-called Tillamook chip).

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- ▶ 16X EIDE CD-ROM Drive
- ▶ 1.44 MB FDD, Win 95 KB, Microsoft Mouse
- ▶ MS Windows 95 CD & Manual
- ▶ Super CD Bonus Pak w/ Extra Games and Microphone
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Perfect Portables

THE VALUE NOTEBOOK

You'll be amazed at what you can get for about \$3,000. Our value notebook starts with a 133-MHz Mobile Pentium processor with MMX and Microsoft Windows 95 (make sure it's OSR 2.1) and adds 16MB of RAM, 256K of L2 cache, a 1.2GB hard disk (minimum), and 64-bit PCI graphics with 2MB of VRAM. This notebook has many high-end features and usually weighs less (under 7 pounds). ☞ If you want to spend only about \$2,000, look for a classic Pentium CPU, a smaller display, and a nickel hydride battery. The notebook should have a full complement of ports, including (left to right, below) a 28.8- or 33.6-Kbps integrated modem, a 115-Kbps or 4-Mbps infrared transceiver, an external VGA port, at least one serial port, a docking-station port, a parallel port, a PS/2 port, a security slot, and at least one USB port. —Carol Venezia

12.1-Inch TFT or DSTN Display

You'll save about \$500 if you opt for a dual-scan screen.

Lithium Ion or Nickel Hydride Battery

We definitely recommend lithium over nickel for maximum battery life.

Two Type II PC Card Slots

Make sure these slots are stacked one on top of the other, so you can use a Type III device.

Full-Size Keyboard, Integrated

Pointing Device In most cases, a value notebook features either a touch pad or a pointing stick.

Multimedia

Your value notebook should have 16-bit audio, at least one speaker, a volume-control thumbwheel, line-in/out jacks, and a microphone.

Fixed or Swappable Options

Some value notebooks feature nonremovable combination CD-ROM/floppy disk drives; others allow you to swap components.



Perfect Portables

THE LIGHTWEIGHT NOTEBOOK

Originally intended for business users who travel by plane a lot, our perfect lightweight notebook, at 5 pounds or less, is a wonder of modern technology. This machine packs a 166-MHz Mobile MMX Pentium processor, at least 16MB of RAM, 256K of L2 cache, 64-bit PCI graphics, at least a 2GB hard disk, and Microsoft Windows 95 (OSR 2.1). If you spend more time in an airplane seat than on your own couch (in other words, you're the ultimate road warrior), consider buying a second battery, a second transformer (one for the office, one for home), and a spare modem in case one burns out on the road. Price: about \$4,000. The lightweight notebook still should have all integrated ports. These include (below, left to right) a 4-Mbps infrared port, an external VGA port, a serial port, a docking-station port, a parallel port, a PS/2 port, a security slot, and a USB port. —Carol Venezia

12.1-Inch SVGA TFT Display

This supports 800-by-600 resolution (the screen is too small for XGA).

Two Type II PC Card Slots Even notebooks that are only an inch thick can accommodate these.

Lithium Ion Battery Accept no less for the ultimate road warrior; you should ideally purchase a second battery (\$200 to \$300) for cross-country travel.

Drive Options Most subnotebooks have external floppy disk drives, although some thicker, slightly heavier (5- to 6-pound) units have integrated drives.

Multimedia This notebook should have 16-bit audio, stereo speakers, a volume-control thumbwheel, line-in/out jacks, and a full-duplex microphone.

Full-Size Keyboard, Integrated Pointing Device



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Perfect Portables

CONNECTIONS

Notebook computers were obviously designed with an eye toward portability and flexibility. But exactly how useful these devices are, both on and off the road, depends entirely on what you're connecting to them. If you're willing to spend a few extra dollars, you can greatly enhance the usability of your notebook. 🐸 If your notebook PC is your only computer, you'll definitely need either a docking station or a port replicator. The notebook's keyboard, pointing device, and screen may be adequate for computing on the road, but if you're using them all day long, you'll appreciate being able to connect to a full-size and full-function desktop keyboard, a larger monitor, and a real mouse. 🐸 If you're constantly on the go, there are many devices available to make connecting—and staying connected—easier, whether you're moving about the office or from location to location. The most widely used of these devices is the combo card: a Type II PC Card that doubles as an Ethernet adapter and a modem. Most standard-issue devices combine 28.8-Kbps modems with 10-Mbps Ethernet adapters. 🐸 Combo cards that support 56-Kbps modem and 100-Mbps Ethernet connections are just coming to market. You should be aware, however, that no standard for 56-Kbps modems exists yet: Currently, two technologies are competing for recognition (U.S. Robotics' x2 and Rockwell's K56flex), and a standard is still months away. In the meantime, keep in mind that in order to realize a true 56-Kbps connection, what you're connecting to on the other end (such as an ISP) must have equivalent hardware. — Carol Venezia

Other Mobile Devices to Consider

PORTABLE CD-ROM DRIVE *If you purchased a notebook without a CD-ROM drive, or if you don't need to have a CD-ROM drive constantly at your disposal when on the road, a portable device is a great add-on. For about \$350, you can purchase a 6X device that weighs a bit more than a pound, runs on batteries (so you don't wear out your notebook's internal battery), and connects via a PC Card.*

PORTABLE VIDEO CAMERA *For videoconferencing on the road over standard telephone lines—with your office or with your family—a portable camera (about \$500) is an obvious necessity. Make sure that*

your notebook is equipped with Windows 95 OSR 2 or OSR 2.1, and that your camera solution supports the H.324 standard for sharing video and voice over a single analog phone line.

GPS PC CARD *If you travel frequently, can't find your way out of a paper bag without a map, and can't always find rental cars with GPS (global positioning system) devices, you may want to consider a GPS PC Card. Priced at about \$150 to \$400, this kind of card uses a standard Type II PC Card slot to connect to your laptop, and it works in conjunction with mapping software that converts data from GPS satellites.*



Port Replicator *To connect easily with an external monitor, printer, or other device while you're deskbound, a port replicator is a must. Obviously, it should duplicate all the notebook's ports; as a minimum, it should have parallel, serial, VGA, keyboard, and mouse ports, and a security slot to deter theft. Price: \$100 to \$125 for a standard port replicator, about \$200 for a device with integrated 10/100-Mbps Ethernet, or about \$350 for a "mini dock" with an integrated Fast Ethernet slot and at least two Type II PC Card slots.*



Docking Station Like the port replicator, the docking station should duplicate all the notebook's ports and have a security slot to lock it up. But because such devices are significantly more expensive than port replicators (most run about \$750), they afford much more functionality. A typical docking station has stereo speakers, a combination of PCI and ISA expansion slots, at least one 5.25-inch drive bay, a SCSI-2 connector, and even an integrated 10/100-Mbps Fast Ethernet connection. Some vendors also offer docking stations that

let you recharge a second battery; the primary battery charges while the notebook is docked.

33.6-Kbps Cellular-Ready Fax Modem If you're constantly in search of an RJ-11 jack to connect to your modem while you're on the road, you should consider a cellular-ready PC Card modem, which is useful for short uploads and downloads.

LAN/Modem Combo Card For connecting your notebook to the network or to the phone line, consider a

combo card. Such a device supports both 10-Mbps Ethernet and 33.6-Kbps fax modem connections in a single Type II card.

Wireless LAN Card If you need to stay connected while you're roaming the office, a wireless LAN card (about \$600 to \$700) is a great solution. You'll need an access-point device as well (about \$2,000). Such devices typically use 2.4-GHz spread-spectrum technology to allow frequency hopping for dynamic network access in the office.

After you've done your spreadsheet, take it for a spin.



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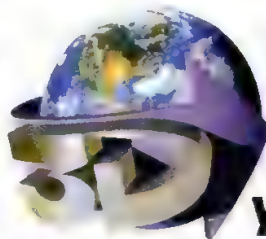
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Perfect Portables PROCESSOR

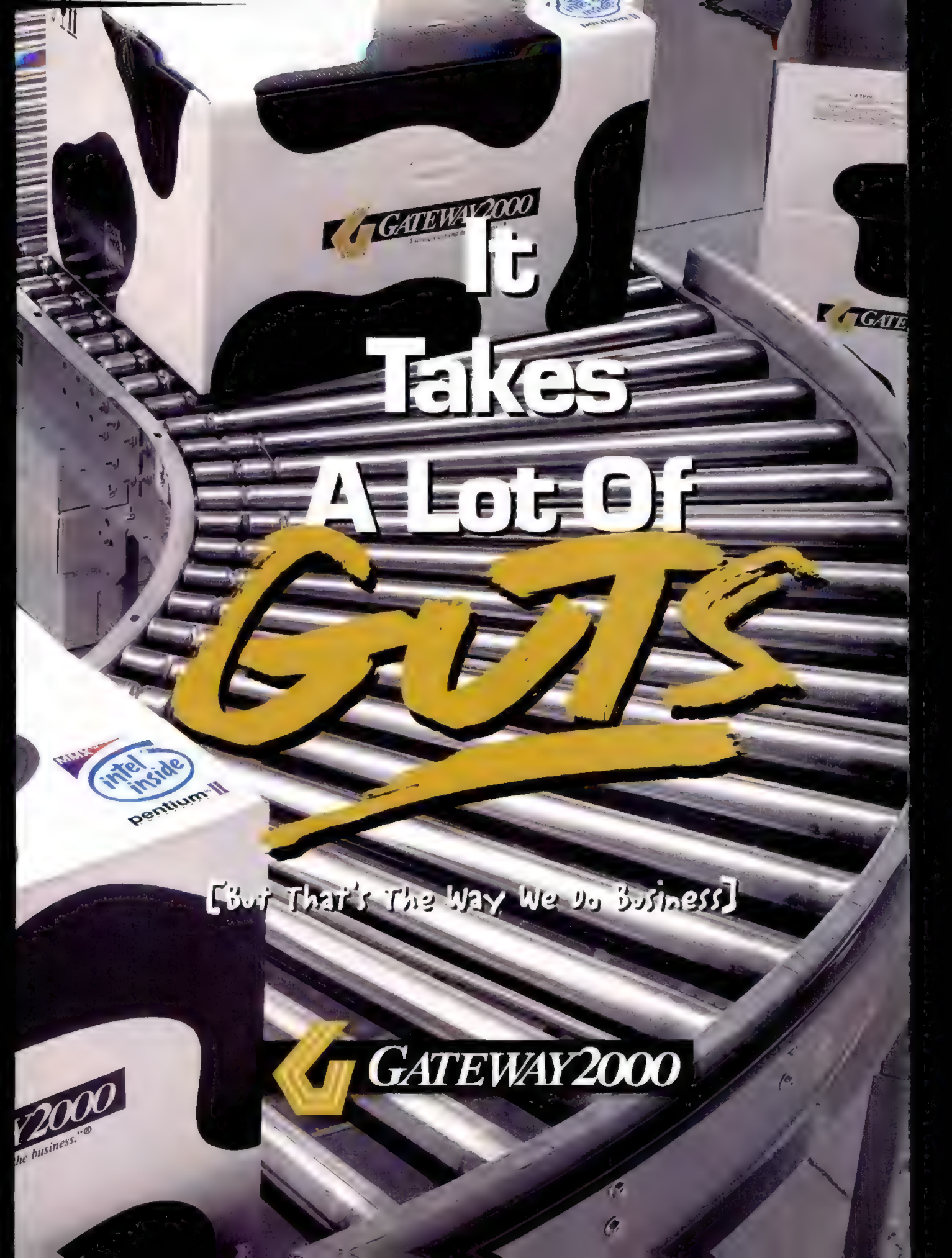
With mobile Pentiums reaching 166-MHz clock speed—MMX Technology included—the CPU speed gap has been narrowed as never before. (For a list of available mobile processors, see “Perfect Desktop Components.”) For general-purpose apps like e-mail, a 133-MHz CPU should suffice. To run more powerful presentation graphics software, we suggest a 166-MHz Mobile Pentium with MMX. 🐉 When it comes to notebook processor packaging, you have a choice: While many vendors have switched to Intel’s *tape carrier package* CPUs to save system real estate and power, some still use ceramic-packaged (or PGA) CPUs in order to deliver notebooks with the fastest processors available. We recommend a machine with a tape carrier package CPU: Core voltages are lower, which saves battery life. 🐉 Coming up are faster mobile Pentium MMX chips (likely 200-MHz) as well as the first mobile Pentium Pro-class CPU (code-named Deschutes, due in early 1998). —Carol Venezia

Pin-Grid Array Packaging Many fifth-generation processors are housed in ceramic packages and plug into the motherboard via pins through a socket (in the Pentium’s case, Socket 7). These chips are typically too power-hungry for a mobile configuration.

Tape Carrier Package Newer Intel CPUs use this format, produced through a process called *tape-automating bonding*. A processor packaged using the TCP process is thinner than a dime and weighs less than a gram. Its core voltage is 2.45V, so it runs cooler and draws less power than a PGA-packaged CPU. It also uses less motherboard real estate.

Mobile Module Intel’s new 4- by 2.5- by 0.4-inch Mobile Module is an integrated assembly that contains the processor (mobile Pentium MMX), the 430TX chip set system controller, the L2 cache, and voltage regulation.





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A Lot Of

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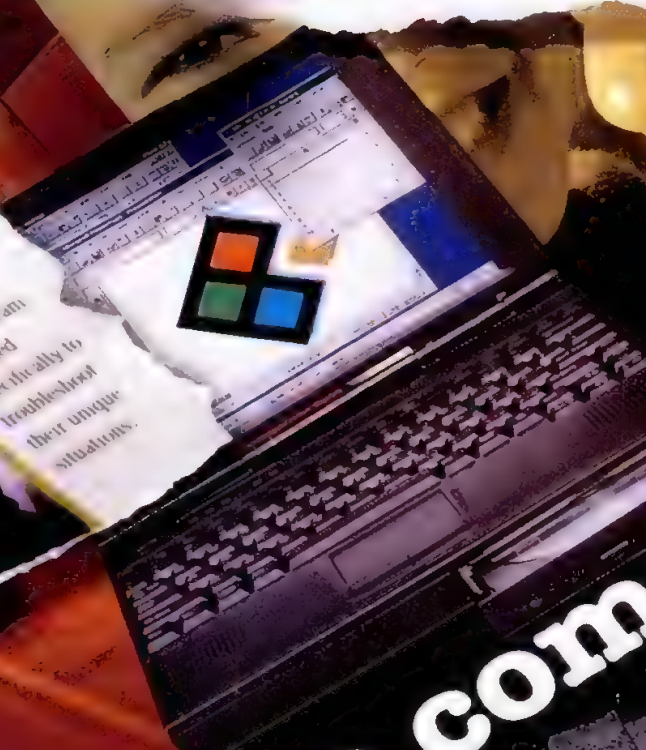
Gateway Does It Again

Last fall Gateway broke away from the pack and launched the Intel Pentium Pro processor into the home PC market bringing 32-bit processing to the masses. People around the globe took advantage of the opportunity and beefed up their home computing. (Sorry Gateway, no pun intended.)

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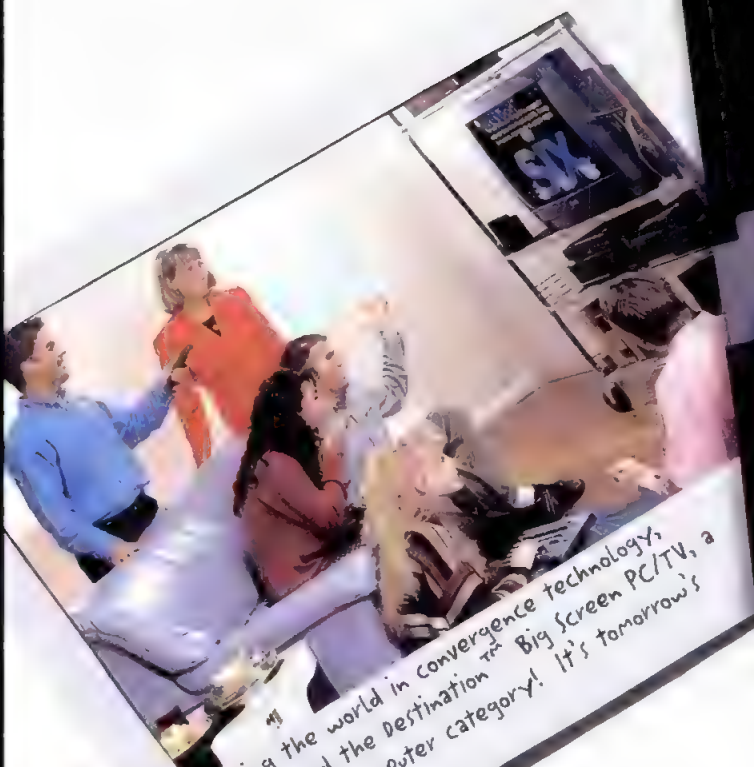
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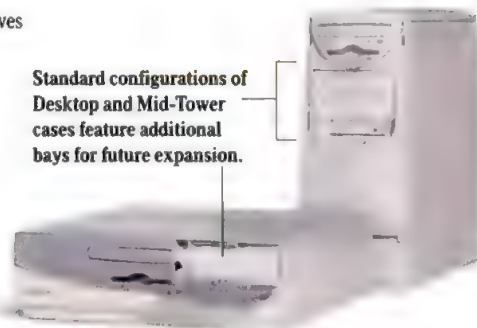
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- 12X SCSI CD-ROM & 3.5" Diskette Drives
- ▶ APC® Back-UPS Pro 650®
- Tower Case
- 104* Keyboard & MS IntelliMouse
- ▶ MS Windows NT® 4.0 & MS Office 97, Small Business Edition plus Encarta 97*
- Gateway Gold Service & Support for Desktop PCs

\$3849 Business Lease* \$141/mo.

G5-200

- Intel 200MHz Pentium® Processor
- 32MB Synchronous DRAM
- 256K Pipelined Burst Cache
- CrystalScan700 .28dp Monitor (15.9" viewable area)
- 2MB 3-D 64-Bit PCI Graphics
- 3.2GB 12ms EIDE Hard Drive
- 12X min/16X max CD-ROM & 3.5" Diskette Drives
- Mid-Tower Case
- 104* Keyboard & MS IntelliMouse
- MS Windows 95 & MS Office 97, Small Business Edition plus Encarta 97*
- Gateway Gold Service & Support for Desktop PCs

\$1999 Business Lease* \$74/mo.

G5-166

- Intel 166MHz Pentium Processor
- 16MB Synchronous DRAM
- 256K Pipelined Burst Cache
- CrystalScan500 .28dp Monitor (13.9" viewable area)
- 2MB 3-D 64-Bit PCI Graphics
- 1.6GB 12ms EIDE Hard Drive
- 12X min/16X max CD-ROM & 3.5" Diskette Drives
- Desktop Case
- 104* Keyboard & MS IntelliMouse
- MS Windows 95 & MS Office 97, Small Business Edition plus Encarta 97*
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D5-166

- Intel 166MHz Pentium Processor with MMX Technology
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- 256K Pipelined Burst Cache
- Destination 31" VGA Monitor
- STB® 2MB Graphics Accelerator w/ Cable-Ready TV Tuner
- 3.2GB 12ms EIDE Hard Drive
- 12X min/16X max CD-ROM & 3.5" Diskette Drives
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- Boston Acoustics® MicroMedia™ 3-Piece Speaker System
- TelePath Modem for Windows with x2 Technology*
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- 256K Pipelined Burst Cache
- 2MB EDO Video RAM
- Modular CD-ROM Drive
- Modular 3.5" Diskette Drive
- Zoomed Video Port
- NTSC/PAL Video Output
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- Gateway Gold Service & Support for Portable PCs

\$3849 As low as* \$134/mo.

2100LS

- 11.3" SVGA DSTN Color Display
- Intel 120MHz Pentium Processor
- 16MB EDO DRAM
- 256K Pipelined Burst Cache
- 1MB EDO Video RAM
- Modular CD-ROM Drive
- Modular 3.5" Diskette Drive
- Zoomed Video Port
- 1GB Hard Drive
- 16-Bit Sound & Stereo Speakers
- NiMH Battery & AC Pack
- 85-Key MS Windows 95 Keyboard
- EZ Pad Pointing Device
- Carrying Case
- MS Windows 95
- MS Works 95
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\$1999 As low as* \$70/mo.

GUTSY UPGRADES (Sold only with the purchase of a system.)

Desktop Upgrades

- **Altec™ Lansing ACS-251 Subwoofer** \$75
- **Altec Lansing ACS-410 Dolby® Surround Sound Speaker System w/ ACS-251 Subwoofer** \$120
(upgrade from PCs that include Altec ACS-41 speakers)
- **Iomega® Ditto™ 3200 Internal Tape Backup Unit** \$199
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- **Iomega Internal ZIP™ 100MB Drive** \$139
(includes three 100MB cartridges)
- **Iomega External ZIP 100MB Drive** \$159
- **Iomega Jaz® 1GB Drive** \$429
(includes SCSI controller and 1GB cartridge)
- **MS® Windows NT® 4.0 Upgrade** \$99
(upgrade from PCs that include MS Windows® 95)

Portable PC Upgrades

- **Gateway Solo™ Mini Docking Station** \$199
- **Gateway Solo Docking Station** \$599
- **33.6 Data™/14.4 Fax Modem** \$200
- **Extra Lithium Ion Battery** \$190

*Maximum data transfer rate dependent on certain variables including particular modems with which you are communicating, telephone lines, communications software and communications protocols

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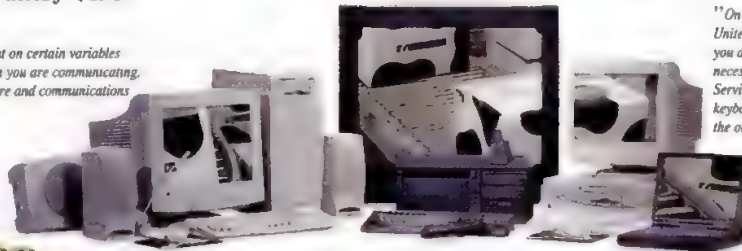
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Perfect Portables

GRAPHICS, STORAGE, & MULTIMEDIA

For many business users, the portable is not an auxiliary PC; it's the primary machine. They need desktop-quality multimedia and reliable, renewable storage. Some high-end notebooks now have a Zoomed Video (ZV) port, a video bus between a PC Card host adapter and the laptop's VGA controller. This feature gives PC Cards direct access to the notebook's video controller, enabling the display of high-speed, uncompressed video for videoconferencing and for use with TV tuners and MPEG decoders (for movies and edutainment CD-ROMs). Likewise, the advent of removable-drive bays in portables has helped alleviate the laptop storage crunch. The best option for personal use (and, of course, the most expensive) is a removable hard disk module. Leading laptop vendors offer such proprietary drives in capacities of 1GB (\$800) to 2GB (\$850). But for sharing data with others or with a desktop system, a cartridge-drive module might be better. Several laptop manufacturers offer Iomega's popular Zip drive (about \$200, and \$14 per 100MB cartridge), and newcomer Avatar offers a magnetic-media disk module (\$300) through several laptop makers, which can store 210MB on each proprietary cartridge (\$40). Your notebook's PC Card slot can mean a world of added functionality. The list below is a small sample of what's available, from the most essential to the really neat.—*Jamie M. Bsales*

PC CARDS

SCSI ADAPTER *With this product (\$200), you can attach the hottest SCSI peripherals—Jaz and SyJet drives, scanners, and CD-ROM drives—to your laptop.*

ETHERNET/33.6 MODEM COMBO *This handy, one-card solution (\$340) serves both as a network connection and as a 33.6-Kbps modem (with 14.4-Kbps faxing).*

ISDN ADAPTER *This device (\$600) gives the mobile professional a high-speed connection for videoconferencing and other tasks at the branch office, at home, at a hotel, or wherever ISDN service has been installed.*

HARD DISK *In its ultracompact pack-*

age, a PC Card hard disk (\$600) provides up to 340MB of capacity for storing sensitive files or transporting large, video-intensive presentations.

WAVETABLE SOUND CARD *With this sound card (\$100 to \$200), you can upgrade laptop audio to true wavetable synthesis for better-sounding presentations and games.*

MPEG DECODER *Notebooks can use an MPEG decoder (\$200) to play CD-ROM-based movies, games, and other MPEG titles.*

GPS RECEIVER *This receiver (\$600) uses global positioning satellites to calculate your latitude, longitude, and altitude within 15 to 30 meters.*



Remote mouse/pointer

Scan converter

Zoomed Video Now standard on some portables, ZV speeds laptops' video playback for tasks such as videoconferencing and MPEG playback.

Drive Modules Swappable modules for hard disks and cartridge drives (such as Zip drives) mean limitless storage. Check a machine's options before you buy it.

4-Pound Printer A lightweight color ink jet printer (\$300) will let you print contracts or fix presentation pages on the road.



Clip-On Speakers If you use your laptop for presenting to a small group, add a pair of clip-on speakers (\$50) for better sound. They're also great for after-hours gaming in your hotel room.

Presenter's Arsenal

If your survival depends on delivering winning presentations on the road, a specialized set of armaments is meant just for you. A **portable LCD projector** (\$5,000 to \$8,000) will let you present to a large or small audience in a

variety of lighting conditions. For most conference rooms, look for a unit that weighs around 15 pounds or less and can deliver 350 ANSI lumens; in a larger venue, you'll need a projector that is brighter (500 ANSI lumens) and bulkier (20 pounds).

Such projectors have built-in speakers good enough to fill a medium-size room with sound, but for larger spaces you'll need **portable amplified speakers** (\$700).

Another option for presenting to a group is to use an NTSC **scan con-**

verter (\$200), or TV video-out adapter, for displaying computer images on any television set. Since you'll want to be in front of the group and not a captive at your keyboard, invest in a **remote mouse/pointer** (\$150), which will let you control your laptop from up to 50 feet away. Deluxe models have built-in laser-beam pointers.

For more interactive presentations, you may need a **wireless keyboard** (\$100) so you can input information and control your PC from anywhere in the room.

Perfect Networks

THE SERVER

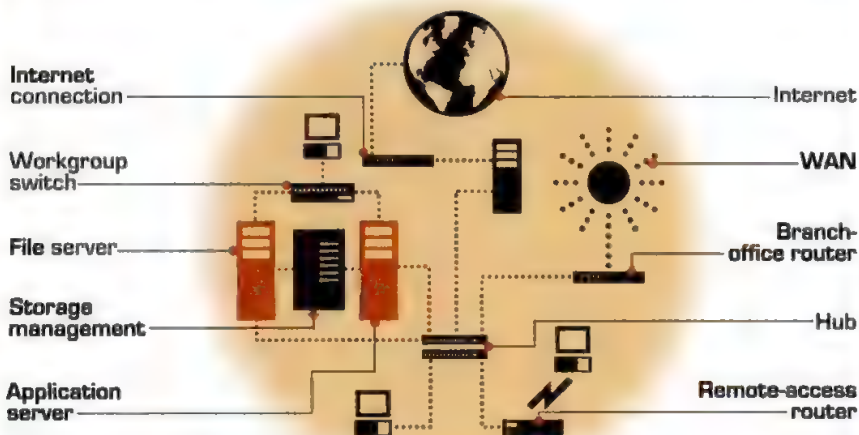


People think of networks as the pipes that carry data and the devices that route it. But the heart of any network is the server. Today's networks rely more than ever before on the data stored on servers, whether you're running an intranet application on

Web servers or deploying network computers, which store all of your data on a server. The perfect network starts with the perfect server, which must provide uninterrupted service and be able to handle increasing demands smoothly. 🐞 A wry old joke among network hands is that a server is just a desktop PC turned on its side. That's not true, unless you think that a Humvee is merely a Yugo with a wider wheelbase. Because servers are so critical to the life of a network, they must include features such as hot-swappable disk drives, fast storage connections, and uninterruptible power supplies (UPSs). Servers process a lot more data than standard desktop PCs, so they must have Fast Ethernet network adapters and much more memory (256MB for a file server, 512MB for an application server). We've put 200-MHz Pentium Pro processors with 512K of L2 cache into our perfect servers instead of Pentium II processors, which do not provide multiprocessing capability beyond two processors and run L2 cache at half the speed of Pentium Pros. 🐞 Servers should be clustered into groups of two or more. Clustering-aware network operating system components are just becoming available for Microsoft Windows NT Server, Novell's IntranetWare, and Sun Solaris. The clustered servers increase performance by distributing application tasks and provide a fail-over reliability in case the primary server goes down. The perfect application server of the future will include at least one clustered partner. File server price: \$15,000. Application server price: \$40,000. —Todd Spangler

Perfect Network Components

The inset diagrams show where each network component fits into the perfect network.

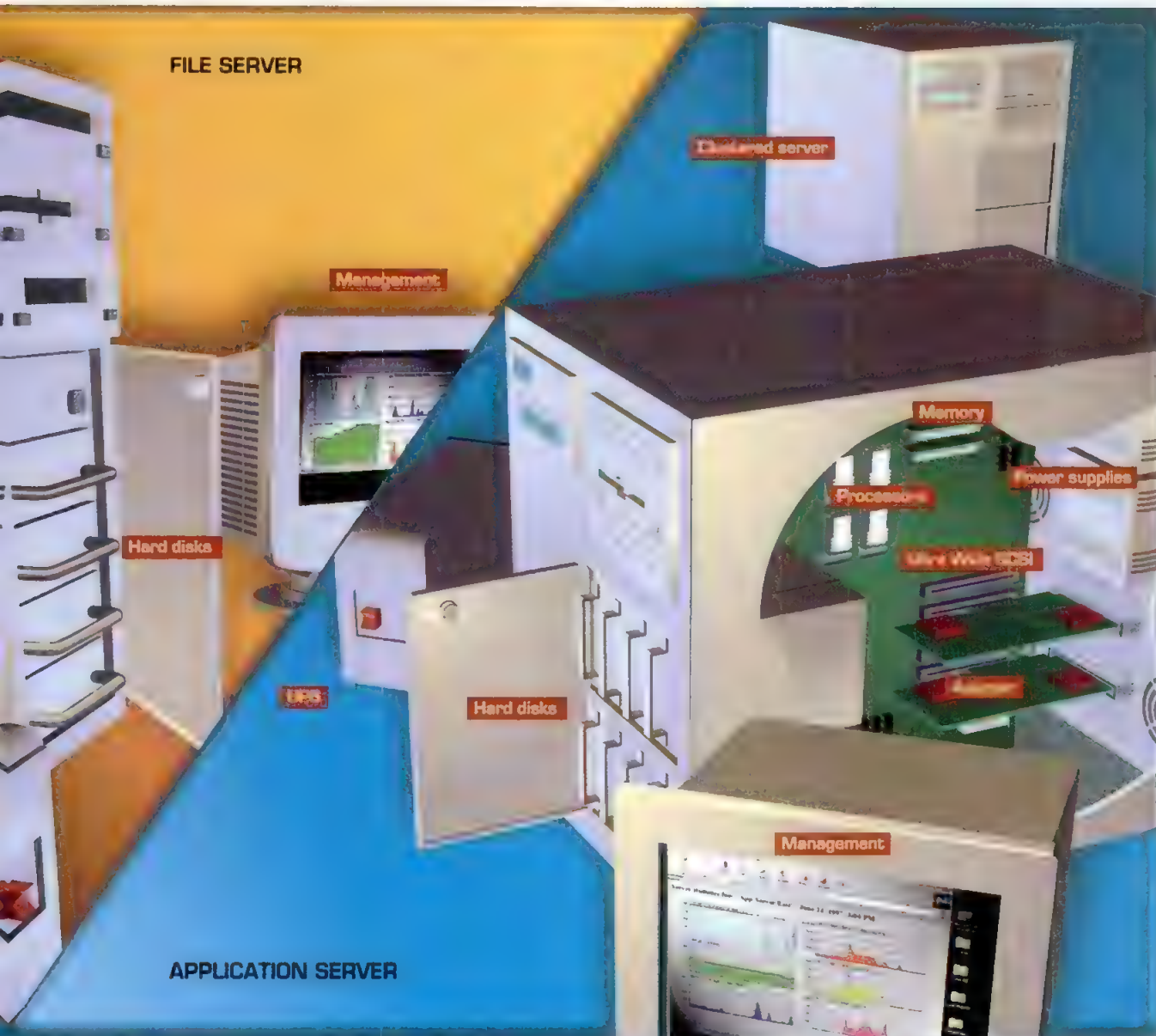


FILE SERVER

Processor The server should have a 200-MHz Pentium Pro with 512K of L2 cache. The server also includes a 12X CD-ROM drive, a 3.5-inch floppy disk drive, a UPS, and an Ultra Wide SCSI connection to the storage device. The server is also rack-mountable.

Network Adapter A 100-Mbps, PCI-based Fast Ethernet adapter ensures that file transfers are not bottlenecked at 10 Mbps. A second adapter provides fail-over capability.

Memory 256MB of ECC (error-correction code) memory is recommended,



and you'll want more if users are sending very large files.

Hard Disks The server should have at least four hot-swappable 2GB hard disks to allow fast and easy replacement of any that fail. RAID Level 5 provides redundancy and enhanced performance.

Network Management Server parameters should be accessible via a Windows console and a Web browser.

Redundant Fan and Power Supply In case one of these critical devices fails, the server includes a second fan and power supply for maximum

uptime. These components are hot-swappable.

APPLICATION SERVER

Processors For maximum processing power, the server has four Pentium Pro/200 processors running on a symmetric multiprocessing operating system. Basic server components include a Fast Ethernet adapter (with a redundant, fail-over adapter) and browser-enabled network management features.

Memory The minimum should be 512MB of ECC memory; more is recommended for large databases and other disk-intensive applications.

Hard Disks Eight 2GB hot-swappable drives provide ample storage and redundancy. RAID Level 5 provides redundancy and enhanced performance.

Clustered Server A second server provides fault tolerance and scalable performance. If the primary server fails, the clustered server immediately assumes full operation. Clustered servers also allow applications to scale across multiple physical machines.

Redundant Fan and Power Supply Like the file server, the application server includes a second fan and power supply for maximum uptime.



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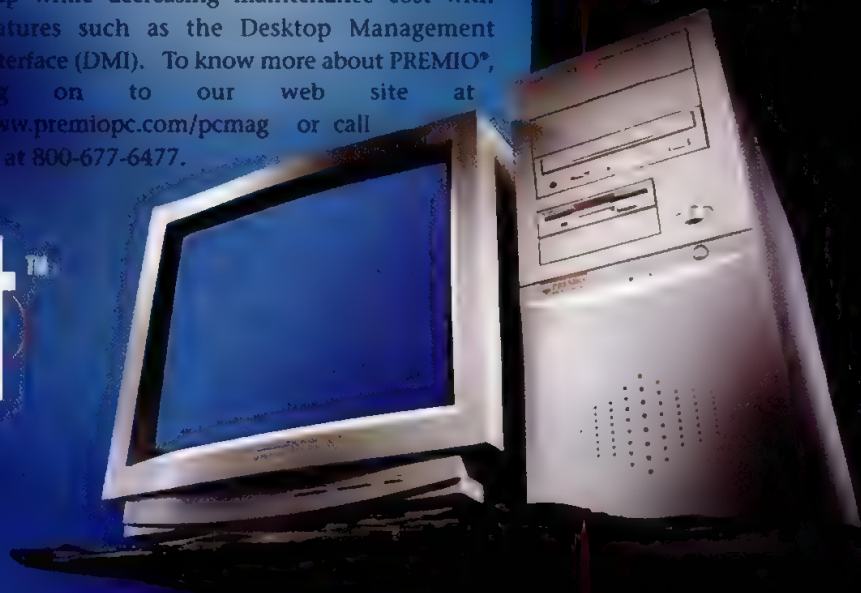
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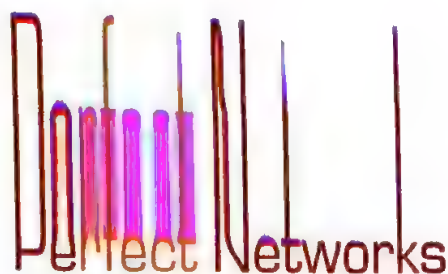
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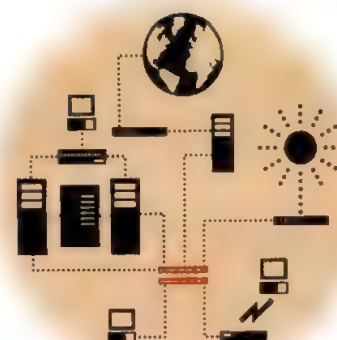
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HUB & ADAPTER

A server is the central element of any network, but hubs and network adapter cards are the basic building blocks of connectivity. Hubs connect network components together, providing a shared connection to the nodes (unlike a switch, which is a device that gives individual PCs a dedicated connection to a server or other resource). 🐸 The perfect hub is stackable, which means you can add more ports and they will appear as one unit to the network. Stackability circumvents the limit on the number of network segments you can have. The perfect hub is also manageable by means of a Web browser or serial-port connection. 🐸 The perfect network adapter is a 10/100 Fast Ethernet card, which automatically configures itself to run at either 10 Mbps or 100 Mbps. (Likewise, the hub can run at 10 Mbps or 100 Mbps on any port.) Most business PCs today include network adapters as standard components. 🐸 Hub price: \$70 per port. Network adapter price: \$50. —David R. Lambert



HUB

Ports For maximum flexibility, the RJ-45 ports should support both 10 Mbps and 100 Mbps. Each port automatically detects the speed at which the connecting device is operating.

Stackable Option Stackable hubs let you connect additional ports easily on a single network segment via a high-speed bus.

Uplink Ports The perfect hub provides fast uplinks to your backbone network, with options for ATM, Fast Ethernet, FDDI, and Gigabit Ethernet.

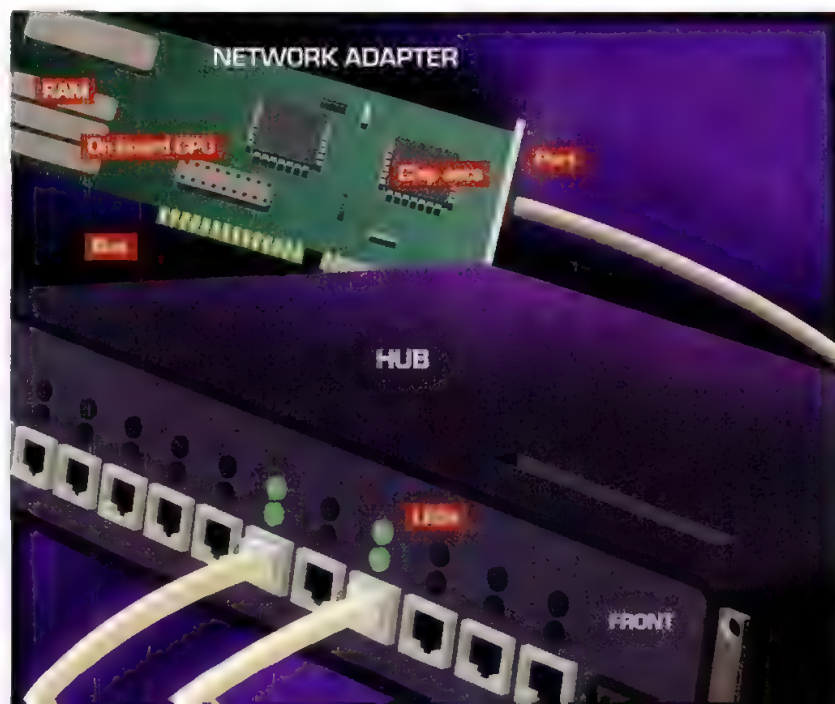
LEDs The indicator lights on the hub can provide quick information on utilization, port integrity, and collisions.

Management All functions should be exposed through a Web browser interface or available via serial-port option.

UPS Connecting the hub or stack to a UPS ensures that the network will stay up in a power outage.

NETWORK ADAPTER

Auto-Sensing Port The network adapter supports both 10Base-T and 100Base-T and can detect automatically which scheme your network is using.



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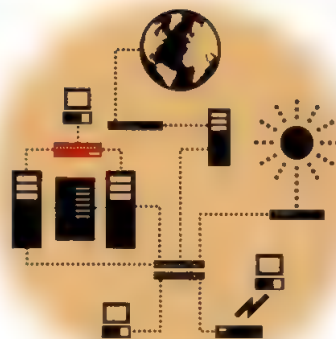
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Perfect Networks

WORKGROUP SWITCH

A workgroup switch performs a function similar to a hub's, connecting desktop PCs to a network. But a switch is much more intelligent than the passive hub. Instead of passing network traffic along without examining it—as a hub does—a switch makes a virtual circuit between the requesting client and its destination, ensuring a dedicated amount of bandwidth. 🐸 On the shared media of a hub-connected Ethernet segment, all your neighbors are competing for the same limited amount of bandwidth. Though a switch is more expensive than a hub, it can relieve congestion in high-traffic networks. 🐸 Of course, the perfect switch has auto-sensing 10/100 ports for flexibility in migrating from 10-Mbps Ethernet to 100-Mbps Fast Ethernet. To provide flexibility, the switch should support 1,024 media-access control (MAC) addresses. A MAC address is a unique hardware identification number assigned to each networking device. Because each of its ports supports multiple MAC addresses, the switch allows administrators to uplink a hub (with several attached PCs) to a dedicated switch port. 🐸 Price: \$400 per port. —Todd Spangler



Ports All of the switch's ports are auto-sensing 10/100 ports.

Stackable Option To increase port density, the switch lets you stack additional switches on top of it via a high-speed bus connector.

Uplink Ports Three high-speed ports allow the switch to connect to two other segments and a local server, using Fast Ethernet, ATM, Gigabit Ethernet, or FDDI.

Management For flexibility, the switch allows configuration and management via SNMP, Web browser, serial-port connection, or Windows console.

MAC Addresses The switch should support 1,024 MAC addresses to provide the option of connecting multiple LAN segments.

LEDs Indicator lights on the front panel provide at-a-glance network traffic, port status, and other data.

Auto-Sensing Frame Types No matter what topology you're using, the switch automatically detects the frame type, with no configuration required.

Power Supplied and Fans To safeguard the nexus of the local network, the perfect switch includes redundant power supplies and fans in case the primary equipment fails.

Processor and RAM The switch must have enough processing and memory capacity to support 100-Mbps operation on each port. For this 24-port switch, the backplane should support at least 2 Gbps.

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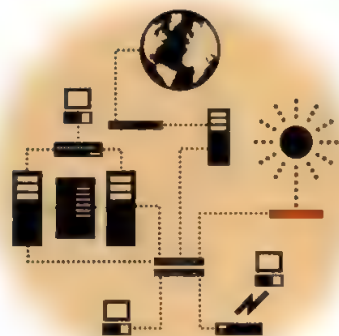
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Perfect Networks

BRANCH-OFFICE ROUTER

Routers are even more intelligent than switches. Unlike switches, which read only the media access control (MAC) address—the hardware identifier of a network device—routers analyze the information contained within a network packet. Routers read each packet and send it over the most efficient path possible to the appropriate destination according to a table of rules. This greater intelligence, though, requires more processing, making routers less efficient than switches or hubs. Routers are most often used to connect geographically separated networks using relatively low-speed technologies, such as ISDN or T1 lines. 🐍 The branch-office router is the lifeline back to headquarters. Because WAN bandwidth is expensive, the router uses data compression and knows when to keep local area network traffic from going out over the connection to the main office. For example, routine status protocols (such as NetWare's Service Advertisement Protocol) are probably relevant only to the users in one location, so the traffic doesn't get routed over the WAN link. That's especially important over a dial-up connection such as ISDN, where use is billed by the minute. 🐍 The perfect branch-office router has an open interface to support any WAN connection. The most common network protocols, IPX and TCP/IP, are supported for easy integration into almost any network. Because there might not be anyone in the office who knows anything about networks, the branch-office router must be capable of remote management. 🐍 Price (with ISDN): \$1,250. —Andrew Go



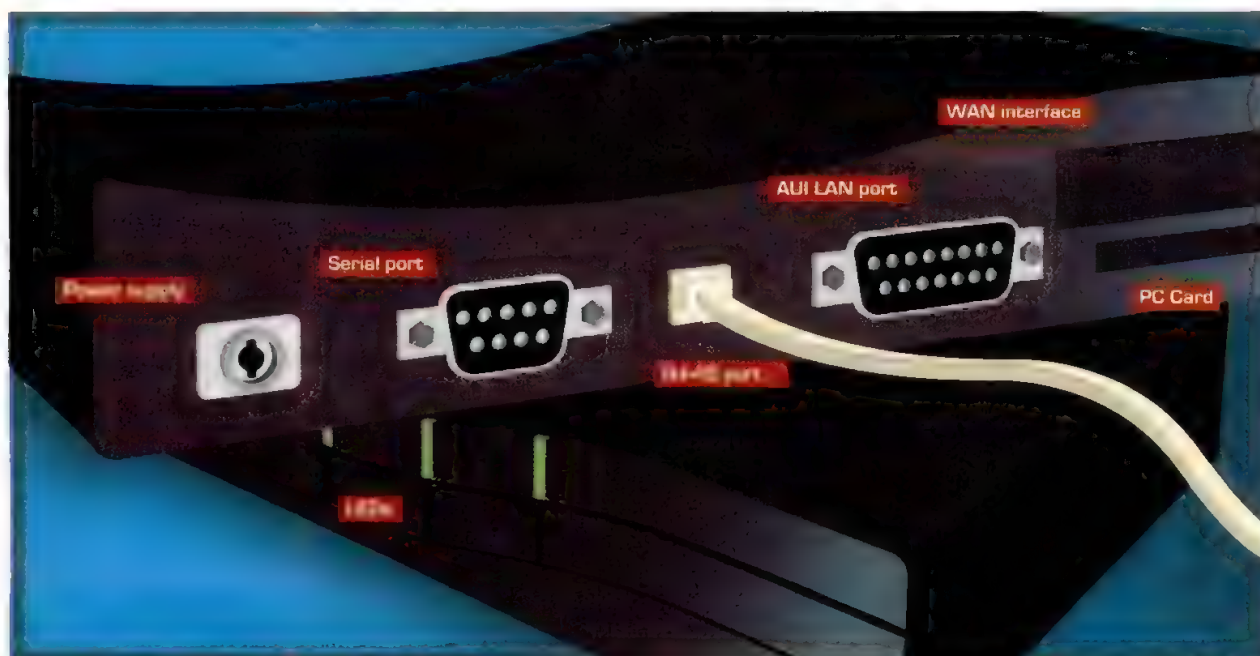
WAN Interface The router includes a modular slot for a variety of wide area networking options, including ISDN, Switched 56, X.25, and frame relay. A redundant connection provides a back-up in case the primary connection fails.

Security For authentication, the router uses CHAP, PAP, and RADIUS, as well as address filtering and dial-back support.

Compression The router supports Ascend, Hi/fn, and Microsoft compression schemes.

PC Card The router has an interface for a PC Card that lets you update the unit's code via flash ROM.

Multiprotocol Support As a bare minimum, the router supports Novell's IPX and TCP/IP. It can be upgraded optionally to support other protocols.



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Pick up the beat with Micron TransPort notebooks. The Micron TransPort XPe is the ultimate in portable, multimedia PC gear for the extreme notebook user. Full presentation capabilities. Superior performance. No compromises. Simply the best your money can buy.

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Take on the most processing-intensive multimedia and communication applications with the greatest of ease through enhanced power, performance and speed.



Mobile Intel Pentium processor
with MMX technology
Intel 430MX PCI Mobile chip set
256KB L2 pipeline burst cache
48MB EDO RAM (80MB max.)

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Brighter graphics. Smoother video. Higher quality sound. It all adds up to an experience in sight and sound that lets you work smarter. Play harder.

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Sharp, clear graphics and smooth video

Sound Blaster 16-bit stereo sound
Built-in stereo speakers and microphone
Rich, vibrant sound

CardBus- and zoomed video-ready
Improved video conferencing

12.1" active matrix color display, 800x600
Room with a fantastic view



PENTIUM® PROCESSOR WITH MMX™ TECHNOLOGY. EXPANDING THE WORLD OF MULTIMEDIA.

All the great things the Intel Pentium processor does for performance, the Mobile Intel Pentium processor with MMX does better. Modem operation. 2D and 3D graphics. Video. Audio. The Internet. Memory. Video conferencing and whiteboard collaboration. MMX technology gives the entire system a boost in performance like never before.

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Flexibility on demand. Swap-in, swap-out components let you adapt to the needs of any job.

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2.1GB hard drive-add a second to beef up storage

3.5" floppy drive for quick file downloads

Lithium-ion battery-add a second to double your computing time

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Get where you need to be on-screen, comfortably and fumble free.

Touchpad

Pointing stick

PLUG-IN PERFORMANCE

2 modular expansion bays

2 type II, 1 type III PCMCIA slots

2 infrared ports, 1 front, 1 rear

S-video and NTSC-video capability

Built-in game port

Headphone jack

Microphone, stereo line-in and line-out jacks

Parallel, serial and 2 PS/2 ports



MICRON TRANSPORT XPe

TRANSPORT XPe P150

150MHz Mobile Intel Pentium

processor with MMX

32MB EDO RAM (80MB max.)

12.1" active matrix color

display, 800x600

1.4GB removable hard drive

Motorola Montana 33.6 fax/modem

\$3,899

TRANSPORT XPe P166

166MHz Mobile Intel Pentium

processor with MMX

32MB EDO RAM (80MB max.)

12.1" active matrix color

display, 800x600

2.1GB removable hard drive

Motorola Montana 33.6 fax/modem

\$4,399

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Its slimmer profile and light weight understate the power inside.
The Transport VLx is the ideal solution for business on the move. And on a budget.

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64-bit PCI graphics accelerator, 2MB VRAM
8X modular CD-ROM drive
Pick-a-Point™ dual pointing devices
Sound Blaster 16-bit stereo sound
Built-in stereo speakers and microphone
Motorola Montana 33.6 fax/modem
CardBus- and zoomed video-ready
2 infrared ports, 1 front, 1 rear
S-video and NTSC-video capability
Built-in game port

Management Pak: MPEG Arcade Player,
ASAP WordPower, Quicken SE,
SPRYNET Internet trial membership
Executive Travel Pak: Greg Norman
Ultimate Challenge Golf, Quicken
ExpensAble, LapLink, Focal Point
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CD-ROM drive, 3.5" floppy drive,
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Custom nylon carrying case
Microsoft® Windows® 95 and MS® Plus! CD
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OPTIONS

MicronDock™ multimedia port replicator
with warm docking and built-in game port
Micron Executive™ desktop package
166MHz Mobile Intel Pentium processor
with MMX™ upgrade
Motorola Montana 33.6 fax/modem
3Com® PCMCIA ethernet adapter, 10-base-T
Samsonite leather carrying case upgrade
2nd intelligent lithium-ion battery
Car adapter
2.1GB primary hard drive upgrade
3GB primary hard drive upgrade
2nd 1.4GB modular hard drive
2nd 2.1GB modular hard drive
16MB EDO RAM upgrade
32MB EDO RAM upgrade
Multimedia Xcitement Pak (comprised of
MMX technology-based software)



TRANSPORT XpE P150

150MHz Mobile Intel Pentium® processor
with MMX technology
32MB EDO RAM (80MB max.)
12.1" active matrix color display, 800x600
1.4GB removable hard drive

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Bus. lease \$133/mo.

TRANSPORT XpE P166

166MHz Mobile Intel Pentium processor with MMX
32MB EDO RAM (80MB max.)
12.1" active matrix color display, 800x600
2.1GB removable hard drive

\$4,399

Bus. lease \$150/mo.

MICRON TRANSPORT XpE

STANDARD FEATURES

Intel 430MX PCI chip set
256KB L2 pipeline burst cache
PCI bus with 128-bit graphics accelerator
MPEG1 compatible
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NiMH battery

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with CD-ROM)
Microsoft Windows 95 and MS Plus!
5-year/1-year Micron limited warranty

OPTIONS

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Source: PC World best overall PC company
for reliability and service, December 1998.

MICRON POWER™ WARRANTY

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1-, 2- or 3-year optional on-site service agreement for Micron desktop and server systems
30 days of free Micron-supplied software support for Micron desktop systems; 3 optional
network operating system incident resolutions included for Micron server systems
30-day money back policy
24-hour technical support
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Perfect Networks

REMOTE ACCESS

Networks increasingly resemble all-night diners. They must be open 24 hours a day, providing access from any location to anyone who happens to need something at 2:00 A.M. ☞ The two basic types of remote access are *remote node* and *remote control*. In the remote-node scenario, a remote user connects to a remote-access server, which controls access to the network. The user is then connected to the network exactly as if sitting in the office, with access to all services and files. A remote-control user, by contrast, controls a single desktop PC. ☞ The advantage of remote control is that instead of entire files, only screen bitmaps and keystrokes are transferred across the communications link. That's ideal for nonmobile applications, but it's a clumsy way to work. Faster remote-connectivity technologies—56-Kbps modems and ISDN today, DSL and cable modems in the future—will allow users to work seamlessly using a more natural remote-node connection. ☞ Price (with integrated ISDN): \$500 per port. —Jennifer L. Anderson



Remote-Node Client The client's operating system detects that the PC is not connected to the network and automatically dials in when a network resource is needed. Security protocols allow remote access via the Internet.

Remote-Control Client To access nonportable applications (such as a mainframe database), a remote-control client initiates a session over a remote-node link. Only screen images and keystrokes are exchanged over the link.

Ports The remote-access server includes integrated ISDN modules, which can fall back to 56-Kbps operation (both x2 and K56flex should be supported) or V.34. Each port has a dedicated processor.

Security For authentication, the remote-access server uses CHAP, PAP, and RADIUS, as well as address filtering and dial-back support. The server supports PPTP or another hardware-based encryption scheme.

Compression For best throughput and compatibility, the server supports Ascend, Hi/fn (formerly known as Stac), and Microsoft compression schemes.

Network Connection The server supports multiple Ethernet connection types (AUI, BNC, and RJ-45).

Multiple Protocols In addition to TCP/IP, the access server can route IPX and bridge all other network protocols.

Management Statistics and diagnostics are available via SNMP, telnet, Web browser, or Windows console.

Perfect Networks

INTERNET CONNECTION

Your network is stretching beyond the boundaries of the corporate firewall. The Internet's low cost and relative efficiency of communication using open standards over a universal network are undoubtedly the wave of future business networking. But security is paramount. When information is the lifeblood of your company, that data must be protected with bulletproof authentication and encryption technologies. The firewall is the centerpiece of your Internet security strategy. The perfect firewall inspects all data coming in and out of the network using a *stateful inspection* technique that compares the data with your defined security profile to make sure that everything passing through is authorized. Using three network adapters, the firewall connects to the Internet, your internal network, and the perimeter network that runs your external FTP, Web, mail, and other services within the secure domain. The firewall is the gatekeeper for communications among remote networks (whether branch offices or another company's networks); it also provides secure remote access to mobile users. Your physical connection to the Internet should have the capacity to support all of your users with bandwidth to spare for peak usage periods. The link must be monitored constantly by your provider for errors and congestion. —Jeffrey G. Witt



CAPACITY To accommodate hundreds of users, the Internet connection is a T3 (45-Mbps) or T1 (1.5-Mbps) link. For fewer than 20 users, ISDN (128 Kbps) is a better choice.

GUARANTEED BANDWIDTH The connection will be able to guarantee preset amounts of bandwidth. Users should be able to reserve bandwidth for use on demand.

SERVICE The Internet connection should be monitored in real time by your service provider. In case of network problems, the provider will

notify you by phone, e-mail, or pager. The Internet provider's changes in routing or bandwidth allocation are done in minutes to minimize disruption of service.

REDUNDANT LINKS In the event of connection failure, traffic is rerouted automatically through other devices.

CONNECTION COST Services that are priced per use (instead of having flat monthly fees), like frame relay or burstable T1, are most cost-effective. The ISP should credit you for failed service and performance problems.



FIREWALL

Firewall Engine Under *stateful inspection*, the firewall intercepts packets at the network layer, analyzing traffic between the physical layer and the first layer of the protocol stack. This allows it to verify all data, regardless of network protocol or application.

Management The administrator has the ability to restrict network client activity by time of day, application, Internet site, or bandwidth allocation.

Platform-Independent Operation The firewall operates as a virtual machine for cross-platform support.



EXTRANET

Virtual Private Networking (VPN)

For network-to-network connections, the firewall creates a high-performance secure connection to encrypt all data and passwords across the Internet.

Secure Remote Access Mobile users connect to the network over the Internet as if they were behind the firewall by using data encryption standards such as IPsec.

PERIMETER NETWORK

Web and FTP Server Public Web and FTP servers hosted internally or at your ISP should contain ample

amounts of memory to cache pages during times of heavy traffic.

Mail Server The e-mail server uses the IMAP4 standard, which allows users to work on- or off-line.

INTERNAL NETWORK

Internet Client The Internet client runs TCP/IP and a Java-enabled browser with integrated newsgroup reader, FTP, and push receiver components.

DNS Server An internal DNS server maintains a database of domain names and corresponding IP addresses.

Proxy Server For increased performance and to minimize traffic over the

Internet connection, a proxy server caches Internet content.

Web Staging Server Site authoring and content creation are tested on the internal Web staging server.

Intranet Server The internal Web server includes password, digital certificate authentication, and SSL security.

SMTP Gateway Server The SMTP gateway allows proprietary mail systems to exchange messages with Internet-based mail servers.

Push Server The push server automatically sends news and information, Web content, software updates, or applications to network clients.

Perfect Networks STORAGE

Network data is only as good as your last backup. To protect server-based data, your storage management solution must provide a fast, reliable way to back up and restore files. Our perfect storage management system consists of a tower that houses your backup media and is connected to a server via an Ultra Fast SCSI adapter or a standard 100-Mbps Fast Ethernet adapter. For best performance and highest capacity, the perfect storage system uses magneto-optical (MO) drives for short-term storage and a digital linear tape (DLT) autoloader for archival storage. The perfect storage management system also includes client agents for automatic backup sessions and allows users to restore archived files. Agents for a wide variety of back-end applications (such as messaging servers and databases) allow administrators to back up information that resides in those programs efficiently. —Amy Leung



Operating System Support The system can back up multiple network operating systems, including Microsoft Windows NT, NetWare, OS/2, and Unix.

Magneto-Optical Drives To back up server data, the unit includes four 4.6GB hot-swappable, high-performance magneto-optical drives.

Tape Drive A six-tape DLT autoloader provides archival storage.

SCSI Interface For best performance, the unit includes an Ultra Fast SCSI adapter to connect to a server. Optionally, the unit can connect to the network via a Fast Ethernet adapter.

CD-ROM The system includes one 12X CD-ROM drive for installing software and sharing CD data.

Power Supply The unit has two hot-swappable redundant power supplies.

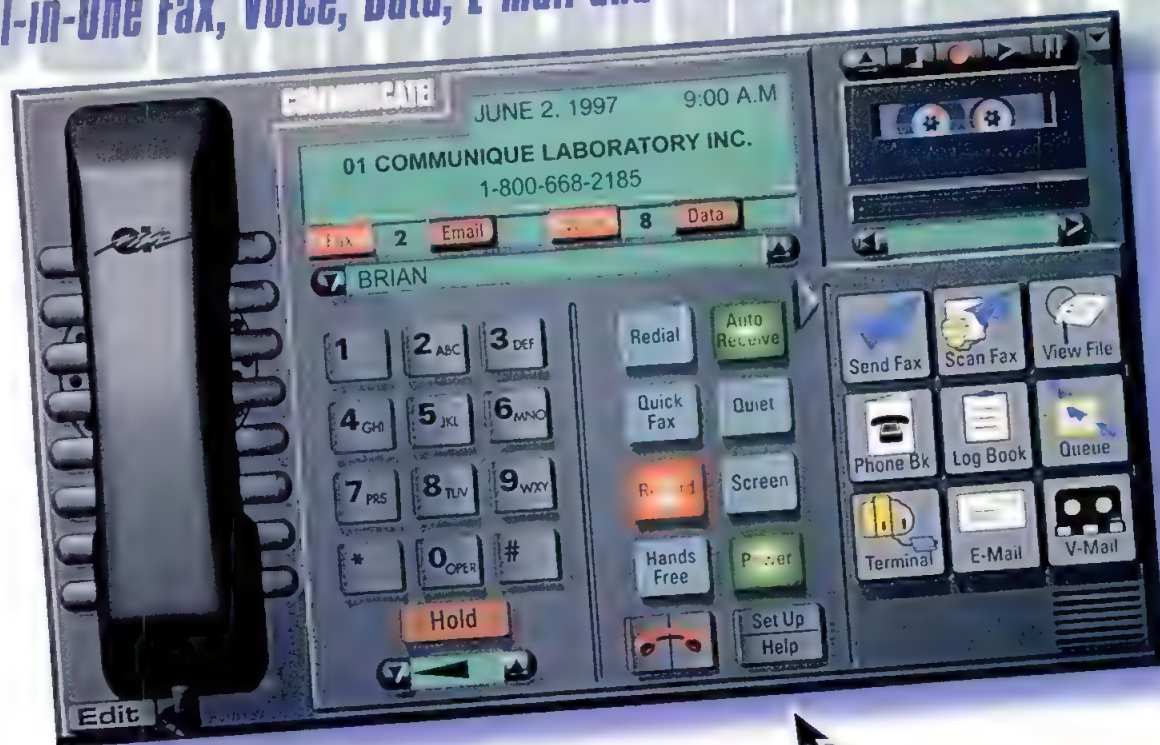
Management The system allows administrators to manage access easily via Web browser, Windows console, or the network operating system's tools. The system's software also allows any user to view and recover archived files.

Server Application Agents For messaging servers and databases, the storage system uses native agents for configurable backup and restore sessions.

Client Backup Agents The storage-system software includes agents for multiple operating systems that can perform both "pull" backup (in which the server specifies which files to back up) or "push" backup (in which the user specifies which files to back up and when).

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COMMUNICATE! is a completely integrated Fax, Voice/Telephony, E-mail and Data Communications software package for Windows. It seamlessly integrates a Contact Manager, Graphics Editor and OCR capabilities under one program icon while using a very familiar telephone/answering machine interface. COMMUNICATE! is the most comprehensive and easy-to-use communications software package available for small business, home office and mobile users.

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-  **Check your phone messages!**
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Perfect Networks

SMALL OFFICE

A small office must compress several functions into standalone devices. The perfect small office uses integrated messaging software to control voice telephony, voice mail, e-mail, and fax. ☞ One PC acts as the voice mail and e-mail server as well as the fax gateway. The communications connection is either two regular analog phone lines or a single ISDN line. The ISDN line provides two channels with separate phone numbers, allowing you to place voice calls over one channel while sending or receiving data or faxes over the other. The LAN carries files, print jobs, and voice telephony among the networked computers. To save space, a single device acts as a printer, fax machine, scanner, and copier. One PC includes videoconferencing, which can run over ISDN or ordinary voice telephone lines. ☞ To connect to the Internet, the small office will use the fastest technology available. If you're sharing the connection among just two or three PCs, a 33.6-Kbps modem can suffice (or a 56-Kbps modem if it's supported by your ISP), but you'll enjoy much speedier Web surfing with an ISDN connection, which provides up to 128-Kbps transmission speed. Other high-speed connection services, including cable and DSL, may be available at reasonable rates. The Internet service provider offers virus protection, firewall, URL filtering, and remote-access services. It also hosts your company's Web page and will set up a vanity domain name so that your Web site and e-mail can use *yourcompany.com* instead of the ISP's domain name as the root domain. ☞ Price (not including PCs): \$4,000. —*Frank J. Derfler, Jr.*

Internet Connection The small-office Internet connection uses the fastest, least expensive service available, whether it's via 56-Kbps modem, cable modem, DSL (digital subscriber line), or ISDN (Integrated Services Digital Network).

Videoconferencing Using either an ISDN connection or a regular telephone lines, the central PC in a small office includes H.323/H.324 videoconferencing capabilities.

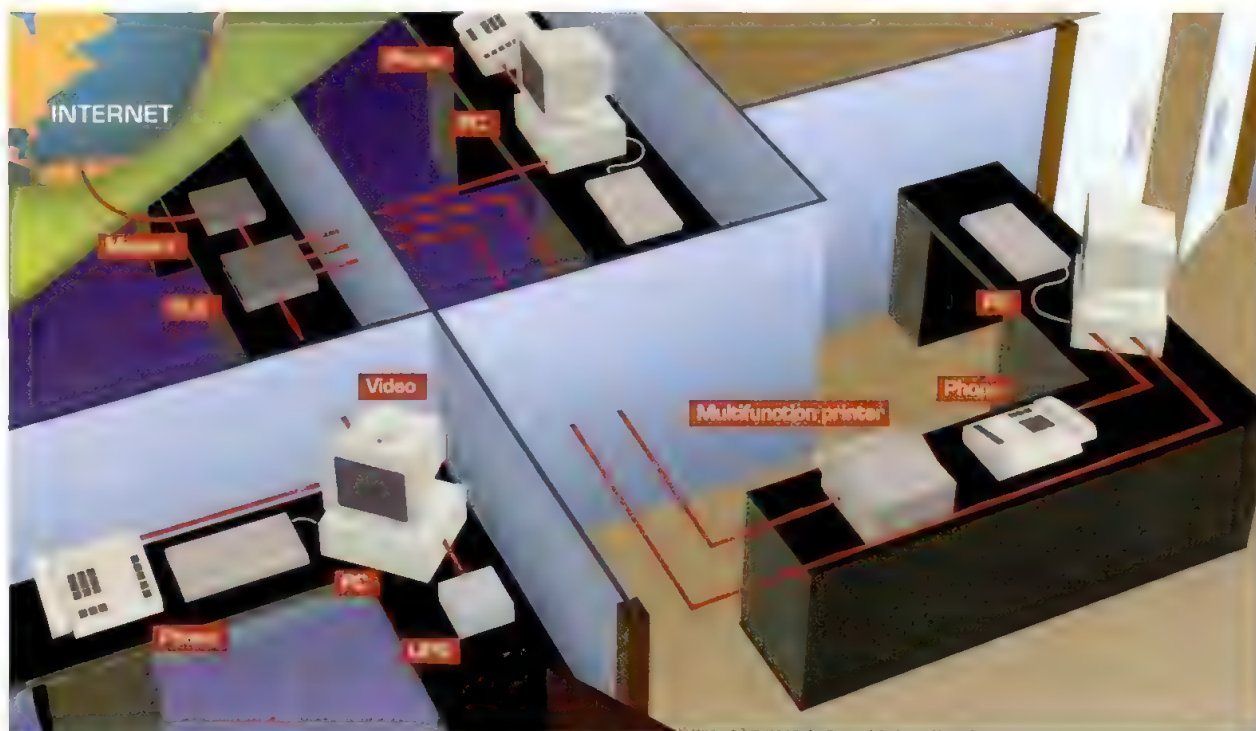
ISDN Line or Two Voice Lines

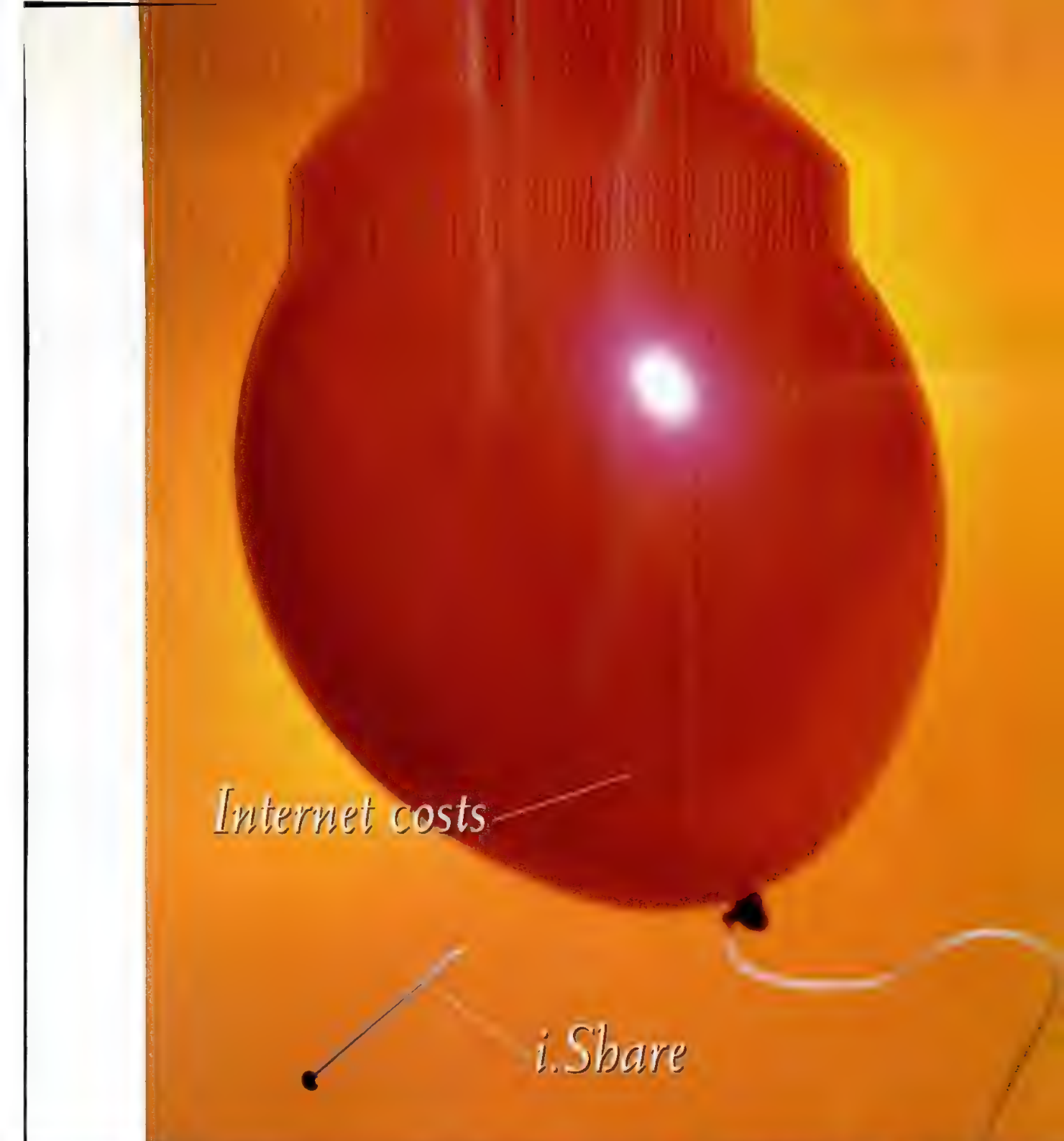
Voice, data, and fax traffic is carried over the same line or lines to the small-office network.

Network Adapter Though most small offices need only 10-Mbps Ethernet adapters, every PC includes a 10/100 adapter to migrate flexibly to Fast Ethernet when the need arises.

Hub The hub can run at 10 or 100 Mbps and has extra ports to add more PCs or other devices as needed.

Multifunction Printer To conserve space and save money, the small office includes a multifunction printer that integrates a network printer with a fax machine, scanner, and copier.





Internet costs

i.Share

Share your Internet connection with i.Share and
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The thought of having everyone online may be a warm and fuzzy one, but the thought of swelling Internet access costs due to multiple lines and modems is enough to make you cringe.

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more features than any other product in its class, i.Share helps users save time and boost productivity. It even includes i.Watch security: an ingenious little feature that enables you to control access to specific URLs and keep employees focused on productive web pages only. All this, combined with award-winning technical support and its starting price of only \$99, will fill you with amazement. (Hopefully not to the bursting point.)

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"...best turnkey solution for linking your IPX-based network to the Internet..."



PC Magazine, Jan. 7, 1997
Best of Year Award

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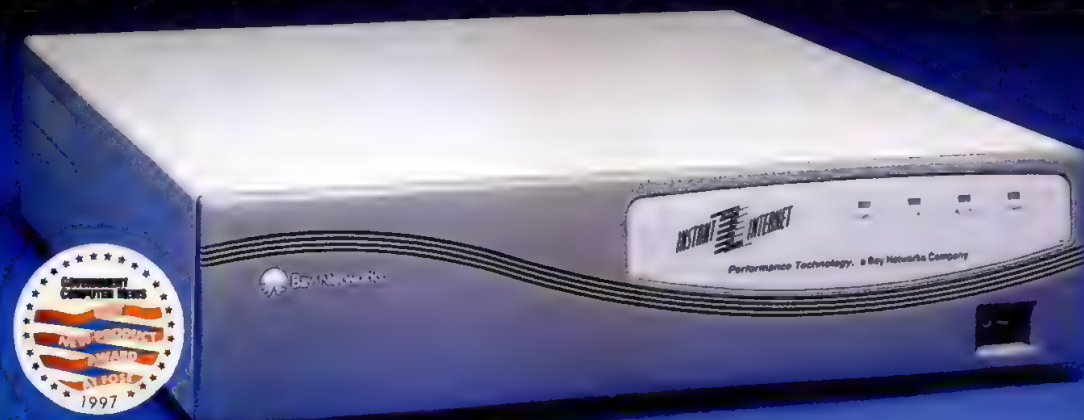


Network Computing, Sept. 15, 1996
Editor's Choice Award

"...easy installation, superior management features, and good performance..."



PC Magazine, Nov. 19, 1996
Editors' Choice Award



Government Computer News, 1997
Best New Product Award

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JDBC Support	yes	no
Support for Oracle, Informix, Sybase, ODBC	yes	no
Windows 95®/Windows NT® support	yes	yes
Macintosh® support	yes	no
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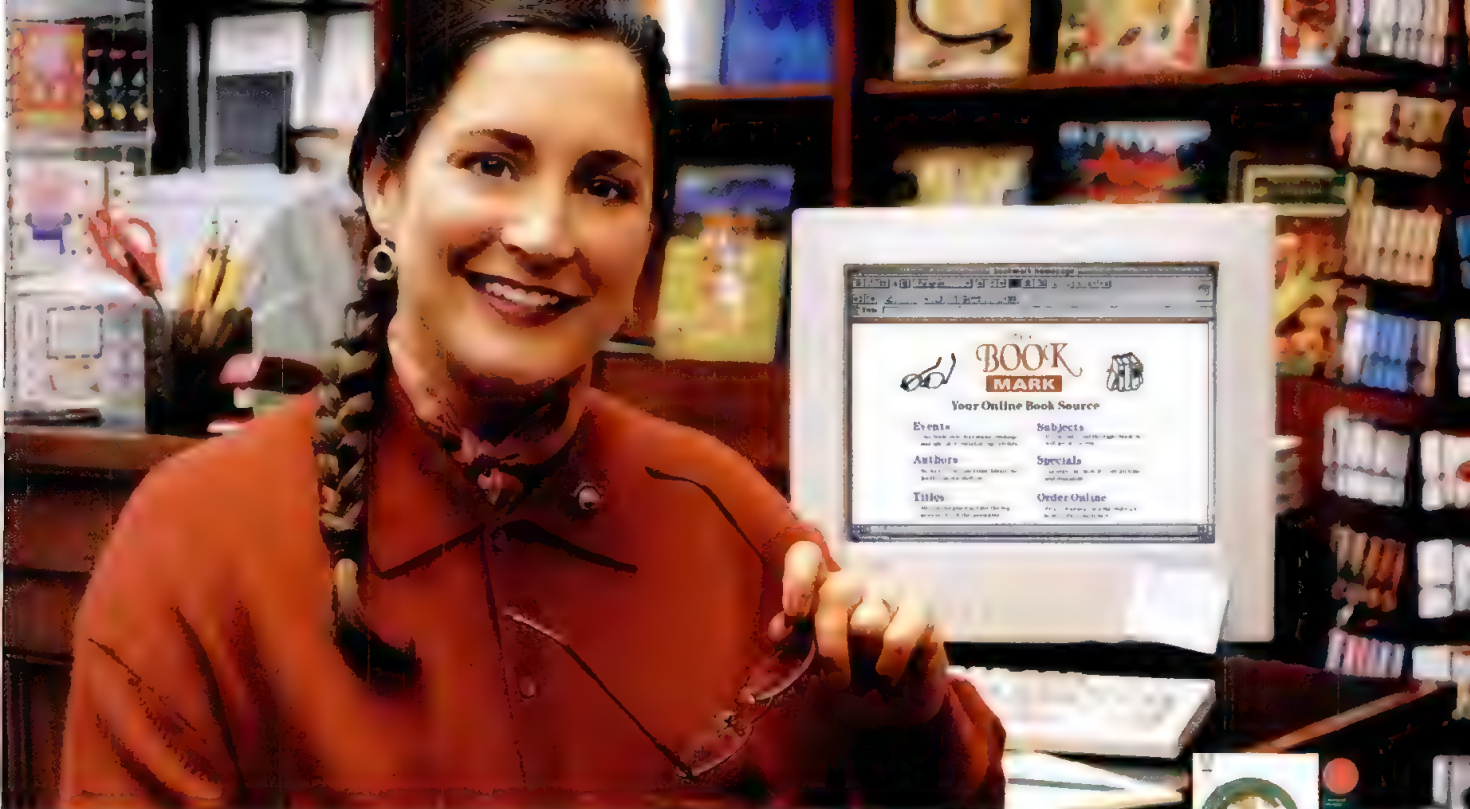
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ComputerLife

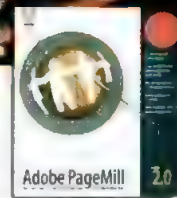
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BY MARY E. BEHR AND
GORDON K. PLUTSKY

Grade inflation may be a hot topic among the nation's colleges and universities. But it certainly isn't evident in *PC Magazine's* annual subscriber survey of Service and Reliability: Only two vendors made it into the winners' circle this year.

The total number of A's has been halved from last year's six to three, and two of this year's belong to Dell Computer Corp. Dell again receives an A for its desktop PCs and moves up to an A for notebook computers. IBM Personal Computer Co. again receives an A for desktop PCs.

Three vendors have fallen from the top spots they held in the past two to six surveys. This year, Compaq Computer Corp.'s desktop score drops to a B and its notebook score drops to a C, ending strings of four and six consecutive A's, respectively. Hewlett-Packard earns a B this year in desktops, ending a five-survey string of A's. The other winner in

last year's notebook category has also declined: Toshiba America Information Systems drops to a B, down from the A it earned in the past two surveys. In most cases, the vendor's inability to score better than average on our survey question regarding recent repairs is what costs it an A grade.

Our survey of *PC Magazine* subscribers rates 30 desktop and 15 notebook vendors (on a scale of A to E) on four key measures: satisfaction with reliability, repair experience, and technical support, and the number of units needing repair in the past 12 months.

This is our tenth survey. Our first such survey was published in 1990 (though it used a different methodology from subsequent surveys). We are continuing to conduct these surveys because we believe quite firmly that service and support policies do more to separate good vendors from mediocre ones than system performance or price. Often, a vendor's service and support track record can be the tie-



breaker in our Editors' Choice discussions, and we feel it can help you in your own buying decisions, whether for your home or your company.

WHY SO FEW A'S?

We believe that PC components become more reliable each year, and virtually every vendor is expanding its service and repair policies. So why is the number of A grades going down, not up?

The answer, we believe, is that it's tougher for a vendor to outshine the competition in each of the four key areas we measure. The vendor has to be above average on all four measures to get an A.

But that doesn't mean there's anything wrong with receiving a B. And in fact, we don't believe a C is a mark of dishonor, either. It means the vendor is just as good as the competition, on the average.

The question on which it is hardest for vendors to excel is how often the unit needed repair in the past 12 months. In fact, only six are above average on this measure. But in conversations with vendors and users over the past year, we've found that when subscribers cite recent repairs, they often include hardware incompatibilities (for instance, a network card's IRQ conflict or problems adding a printer to the new PC might be chalked up as a repair).

The upside is that users are generally satisfied with their systems. The overall averages for the three satisfaction ratings are at the same level as they were last year for both desktops and notebooks. As for *recent repairs* (the number of units that needed repairs in the past 12 months as opposed to satisfaction with repair experience, which we call *repair satisfaction*), desktops and notebooks have needed repairs almost as

often as last year: The desktop average of 32 percent equals that of last year, while the current notebook average of 30 percent has improved from last year's 33 percent.

THE WEB WEIGHS IN

The Internet is playing a more prominent role in service and support this year than ever before. In phone interviews with vice presidents, managers, and directors of customer support, we heard many of them touting an expanded presence on the Web. Kriss Kirchhoff, manager of Hewlett-Packard's U.S. Customer Support Center, says that its Web sites let HP offer "minimum downtime and maximum education and self-sufficiency."

On the other hand, the Web can work to a vendor's disadvantage. One angry and disappointed Compaq customer has created a venomous Web site that catalogs his ongoing problems, not to mention the experiences of other unhappy customers.

SURVEY SPECIFICS

In February, we mailed surveys to 17,000 *PC Magazine* subscribers, asking them for their opinions on the quality of service and technical support they received from PC vendors in the past two years. We closed the survey when we received a 50 percent response rate. These responses rate more than 14,000 desktop PCs from 30 vendors and nearly 3,800 notebooks from 15 vendors.

We asked survey respondents 14 questions each for desktops and notebooks, four of which count toward our Service and Reliability grade:

- satisfaction with reliability;

- satisfaction with repair experience (*repair satisfaction*);
- satisfaction with technical support;
- the percentage of units that have needed repair over the past 12 months (*recent repairs*).

This has been our methodology for the past three surveys; before then, grades were based on just the three satisfaction measures. We also asked whether or not the respondent would buy a new PC from the same vendor; this question doesn't count toward the grade, but we believe it succinctly summarizes how a user feels about a vendor.

HOW WAS YOUR REPAIR EXPERIENCE?

In addition, we explored a subtopic to provide new insights into subscribers' experiences. We asked how much time was spent on hold when calling tech support and what happened when a technician was reached. These results are reported in the table "Repair and Support Experience."

On the average, when a repair is necessary, our survey finds that desktop vendors can help solve the problem over the phone 24 percent of the time. The vendor sends a new part 26 percent of the time, while the dispatch of a repair technician is necessary 29 percent of the time. The desktop is sent out for repair 23 percent of the time.

This profile is different for notebooks. Problems can be solved over the phone 20 percent of the time. The vendor sends a new part 27 percent of the time. While 29 percent of desktops are fixed on site by a repair technician, only 12 percent of notebooks are fixed in this manner. But the notebook is sent out for repairs 48 percent of the time, more than double the rate of desktops.

MAKING THE GRADE

Here's how we arrived at the grades.

- **A:** The vendor has better-than-average scores on all four key measures: satisfaction with reliability, repair experience, and tech support; and the need for recent repairs.

READERS' REPORT CARD

Desktop Vendors

A	Dell
	IBM
	Apple
	Compaq
	CompuAdd
B	Digital
	Epson
	Gateway
	Hewlett-Packard
	Insight
	Micron
	Toshiba
	ZEOS
	ALR
	AT&T GIS
C	MidWest Micro
	NCR
	NEC
	Northgate
	Quantex
	Acer
	AST
	DTK
	Everex
	Leading Edge
D	Packard Bell
	Tandy
	Unisys
	ZDS
	CompuDyne

- **B:** The vendor has a better-than-average score on at least one key measure and average scores on the others.
- **C:** The vendor has average scores on all four measures or a combination of better-than-average and worse-than-average scores.
- **D:** The vendor is worse than average on at least one key measure and average on the others.
- **E:** The vendor receives worse-than-average scores on all four of the key measures on our survey.

A BLAST FROM THE PAST

Note that this survey covers machines used in the past two years. As a result, we include data from several companies that are no longer in business or are no longer marketing PCs.

CompuAdd Computer Corp., Leading Edge, and Northgate Computer Systems are out of business altogether. CompuDyne Corp. and Tandy Corp. no longer manufacture PCs. Epson no longer sells desktops or notebooks in the United States, although it does sell them in Latin America. Insight no longer sells its own brand of PCs, although it has a healthy mail-order business selling other brands.

AND ALL THOSE MERGERS

We also include data regarding several computer companies that have changed in status since our last survey. In June 1996, NEC Corp. and Packard Bell merged to form Packard Bell NEC. The new company offers three distinct brands of PCs: NEC, Packard Bell, and Zenith Data Systems (ZDS). We rate these brands separately. And Micron purchased ZEOS in 1996 and subsequently phased out the ZEOS brand name.

Also in 1996, AT&T GIS split from NCR and dropped out of the PC business. Today, NCR focuses on client/server enterprise solutions.

DESKTOPS: A PAIR AT THE TOP

This year's two Readers' Choice winners in the desktop category, Dell and IBM, both make a return to the top, IBM for the fifth straight year and Dell for the second. In the past year, Dell has broadened the scope of its Web site with 35,000 pages of technical data going

back to the 8088. Also, in October 1996, Dell added a dedicated ten-digit number on a sticker to each machine; called the Express Service Code, this identification

number can be punched in by a user calling the service telephone number to direct the call to the correct queue.

Dell also may have the benefit of demographics on its side. According to the vendor, 92 percent of its customers are in business, government, or education; such users are more likely to have IS departments. Our numbers are slightly less dramatic than that: Of all the respondents who use a Dell machine, 63 percent of them say that they use it for their work.

A BEVY OF B'S

The majority of desktop vendors (11 out of 30) fall into the B category. To earn a grade of B, a vendor must have a combination of above-average scores and average ones. Within the B category, these vendors generally fall into one of four groups.

In the first category are former A ven-

READERS' REPORT CARD

Notebook Vendors

A	Dell
B	Hewlett-Packard
	IBM
	Micron
	NEC
	Toshiba
C	Apple
	Compaq
	Gateway
	WinBook
D	Acer
	AST
	Texas Instruments
	ZDS
	ZEOS



DESKTOPS

DELL COMPUTER CORP.

IBM PERSONAL COMPUTER CO.

NOTEBOOKS

DELL COMPUTER CORP.

Service and support are the two key elements in producing an exceptional personal computer, and this year it's harder than ever before to be rated as exceptional in our Service and Reliability survey of *PC Magazine* subscribers.

This year, there are just three Readers' Choice award winners where last year there were six. Dell Computer Corp. receives awards in both the desktop and notebook categories, and IBM Personal Computer Co. gets credit for winning desktops. Among desktop vendors, this is the fifth straight award for IBM and the second straight one for Dell. As in the notebook category, Dell was last so honored in July 1993.

To get a mark of A and thus win a Readers' Choice award, a vendor has to be ranked above average on all four of our key ques-

tions: satisfaction with reliability, satisfaction with repair experience, satisfaction with technical support, and the number of units that have needed to be repaired in the past 12 months (recent repairs).

The recent-repairs question proves to be a major stumbling block. Of the 30 desktop and 15 notebook vendors, there are seven scores of above average on the recent-repairs question. Five companies receive above-average scores on the three satisfaction questions but not on the question about recent repairs. As a result, they fall short of receiving the highest possible rating. These companies include Gateway 2000, Hewlett-Packard, and Micron, as well as first-time survey participant Quantex in the desktop category and Hewlett-Packard and Micron in the notebook category.

Note that overall satisfaction with PCs and notebooks is quite high, so vendors receiving overall grades of B and even C are providing generally capable service and support.

Our survey was mailed to 17,000 subscribers. We closed the survey when we received a 50 percent response rate (see the sidebar "How We Surveyed" for more details). In this process, our respondents rated nearly 18,000 individual PCs.



How We Surveyed

In February 1997 we mailed 17,000 questionnaires to a randomly selected sample of *PC Magazine* subscribers. The survey was closed for tabulation on April 14, at which time we had achieved a 50 percent response rate. Willard and Shullman, a research firm based in Greenwich, Connecticut, tabulated the survey.

The survey covered desktop PCs, notebooks, and software applications. The software results can be found in "Readers Rate Support and Satisfaction" later in this issue.

Each survey respondent described up to five desktop and notebook PCs used over the past two years, including the one used most often. Then, on a scale of 1 (worst) to 10 (best), respondents rated their satisfaction with PC reliability, repair experience, and technical support received. They also indicated the number of times their PCs needed to be repaired in the past 12 months. The results of these four measures are the determining criteria for our Readers' Report Card grades.

Only vendors that received at least 50 responses, which we considered the minimum amount of data necessary to produce statistically reliable results, were included in the final tabulations.

To analyze the results, we focused on each question individually and calculated a score (an average of the ratings) for each desktop or notebook manufacturer. As a standard of comparison, we calculated an overall average for each measure by adding the individual manufacturer scores and dividing it by the number of manufacturers rated.

We report the survey findings in terms of how the scores for each PC manufacturer compare with the overall averages. We made these designations using a *t-test*, a standard statistical procedure used to identify differences from the average that are significant at the 95 percent confidence level. *T-tests* take into consideration the ratings, the amount of variation among them, and the number of ratings received. These components determine the confidence

interval for each score, or the range into which we are 95 percent certain that the score falls. The fewer the ratings and the greater the amount of variation among the ratings, the larger the range will be. Only when the range is entirely above or below the overall average is the vendor's score considered significantly different from the average. Therefore, it's possible for one product to appear in the average range while another with the same score comes out as significantly above average. — Rachel Derby Teitler and Samantha J. Edwards

READERS RATE			
● Significantly better than average			
○ Average			
● Significantly worse than average			
DESKTOP VENDORS		Units Needing Repair over the past 12 months	Satisfaction w/ Reliability
Acer/Altos (451)	○ 36%	○ 7.6	
ALR (68)	○ 36%	○ 7.7	
Apple (507)	● 22%	○ 7.9	
AST (501)	○ 35%	● 7.6	
AT&T GIS (147)	○ 33%	○ 7.7	
Compaq (1,716)	● 29%	● 8.1	
CompuAdd (106)	● 18%	○ 7.8	
CompuDyne (104)	● 43%	● 7.2	
Dell (1,740)	● 28%	● 8.7	
Digital (272)	○ 30%	● 8.1	
DTK (121)	● 43%	○ 7.7	
Epson (77)	● 18%	○ 7.4	
Everex (81)	○ 35%	● 7.0	
Gateway (2,807)	○ 32%	● 8.8	

Though two vendors may receive the same numerical score, when *t-tested* against the average, one may emerge as significantly better or worse than average while the other does not. This can happen because *t-tests* consider not only the individual ratings but also the number of responses and the amount of variation among them. A larger number of responses or a smaller amount of variation among the ratings increases the likelihood that a given product's score will be significantly different from the average.

- Significantly better than average
- Average
- Significantly worse than average

dors that have dropped a notch: Compaq and HP. This year, Compaq's repair satisfaction rating drops from above average to average, resulting in its grade change. All of the company's other grades are above average. Compaq's \$35 charge for a "non-Compaq problem" has had many consumers up in arms on Web sites; whether this is the reason for the fall in status is unclear. Regardless, Compaq recognizes that this indeed is a problem, and it has recently announced a new policy of offering free telephone technical support. This support covers the system as

well as all bundled software and peripherals. An average score on recent repairs keeps Hewlett-Packard from winning its sixth consecutive grade of A.

In the second group are steady performers that have had B's on at least the past two annual surveys. This group includes Apple

Computer, Digital Equipment Corp., Gateway 2000, and Micron Electronics. Direct vendors Gateway and Micron just miss the top: Both are average on recent repairs but above average on all other criteria.

The third group in our survey consists of first-time vendors. Here, Toshiba makes its debut with a grade of B. This is quite impressive, given the fact that the company began shipping its desktops only in September 1996. All scores are average except for an above-average score for satisfaction with overall reliability. Toshiba's buy-again score is also



TIME ON HOLD

According to our survey, Packard Bell takes 22 minutes to answer the phone (versus a 12-minute average). Beny Alagem, CEO of Packard Bell NEC, says it's now down to 3 minutes.

When This Is Your Limit



GATEWAY2000
S O L O™

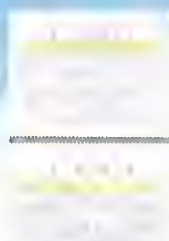


On the road or in the office, Gateway Solo portable PCs have the computing solution.

Our Gateway Solo 9100 notebook packs the rich features of a desktop PC into a portable package.



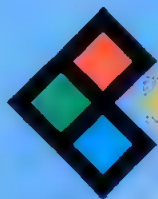
Just plug your Gateway Solo portable PC into the Gateway Solo Docking Station and it's transformed into a desktop configuration that connects to external monitor, keyboard and peripherals in one step. You can even dock your Gateway Solo PC without rebooting it.



Gateway builds fresh technology into all our portable PCs to help extend their useful life spans. The Gateway Solo 9100 notebook features Intel's Mobile Modules Operation card — it's a combination of the processor, cache and a portion of the core logic chipset in a modular component.



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- 4MB Video RAM
- USB & Zoomed Video Ports
- NTSC/PAL Video Input And Output
- 3GB Hard Drive
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- 16-Bit Wavetable Sound & Stereo Speakers
- 33.6 PCMCIA Data™/14.4 Fax Modem
- Two 12-Cell Lithium Ion Batteries & AC Pack
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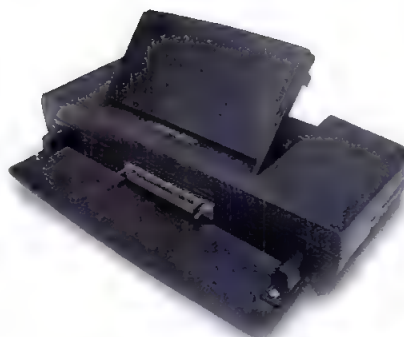
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Gateway Solo Docking Station

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READERS

RATE

PC Vendors

- Significantly better than average
 Average
 Significantly worse than average

Satisfaction with:

Units Needing Repair over the past 12 months

Reliability

Repair

Tech Support

Buy again?

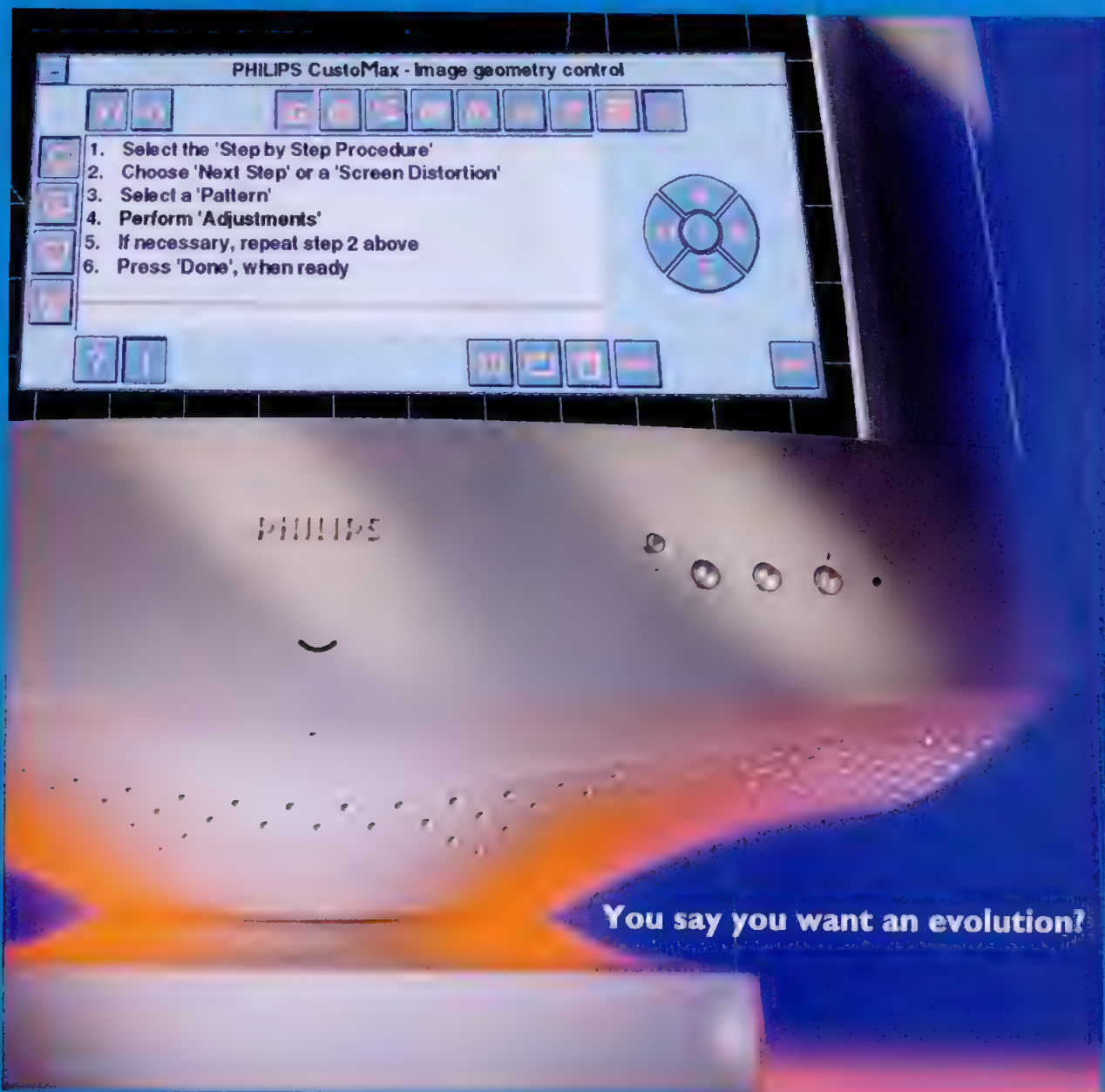
DESKTOP VENDORS (NUMBER OF RESPONSES)

Acer/Altos (451)	36%	7.6	7.3	6.5	6.2
ALR (68)	38%	7.7	7.4	6.4	5.3
Apple (507)	22%	7.9	7.6	7.3	5.7
AST (501)	35%	7.6	6.9	6.4	5.7
AT&T GIS (147)	33%	7.7	7.5	7.2	5.0
Compaq (1,716)	29%	8.1	7.4	7.1	6.8
CompuAdd (106)	18%	7.8	7.1	6.7	4.2
CompuDyne (104)	43%	7.2	6.5	5.5	4.4
Dell (1,740)	28%	8.7	8.4	8.0	8.4
Digital (272)	30%	8.1	7.7	7.3	6.2
DTK (121)	43%	7.7	7.3	6.7	5.3
Epson (77)	18%	7.4	7.6	7.0	5.3
Everex (81)	35%	7.0	6.8	6.2	4.1
Gateway (2,607)	32%	8.8	8.2	7.8	8.2
Hewlett-Packard (731)	29%	8.3	7.8	7.5	7.4
IBM (1,660)	27%	8.0	7.6	7.5	6.7
Insight (50)	32%	8.2	8.1	7.4	6.4
Leading Edge (109)	33%	7.1	6.6	5.0	4.4
Micron (738)	32%	8.8	8.3	8.0	8.6
MidWest Micro (99)	40%	7.9	7.6	7.1	6.8
NCR (60)	35%	7.7	7.1	6.8	4.3
NEC (326)	29%	7.8	7.3	6.9	6.5
Northgate (79)	23%	8.0	7.9	7.3	3.8
Packard Bell (1,009)	33%	7.1	6.4	5.8	5.3
Quantex (126)	43%	8.4	8.1	7.7	7.8
Tandy (115)	26%	6.9	6.6	6.0	3.1
Toshiba (230)	29%	8.2	7.5	6.9	7.3
Unisys (81)	35%	7.2	6.9	6.5	4.6
ZDS (169)	33%	7.2	6.7	6.2	4.1
ZEOS (270)	33%	8.1	7.5	6.8	5.4
AVERAGE	32%	7.8	7.4	6.9	5.8

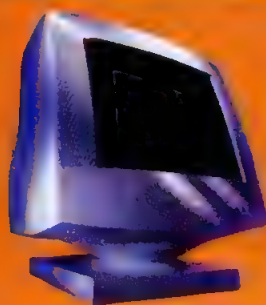
NOTEBOOK VENDORS (NUMBER OF RESPONSES)

Acer/Altos (75)	41%	7.5	6.6	6.3	6.4
Apple (114)	26%	7.8	7.3	7.4	6.2
AST (135)	33%	7.6	6.8	6.8	6.0
Compaq (557)	30%	8.0	7.2	7.4	6.9
Dell (322)	25%	8.6	8.0	7.9	8.1
Gateway (259)	28%	8.2	7.4	7.6	7.7
Hewlett-Packard (87)	25%	8.5	8.0	7.9	7.7
IBM (649)	32%	8.3	7.5	7.7	7.6
Micron (107)	23%	8.7	8.3	8.4	8.9
NEC (181)	32%	8.2	7.9	7.7	7.0
Texas Instruments (160)	36%	7.8	7.1	7.3	6.6
Toshiba (884)	28%	8.3	7.1	7.2	7.8
WinBook (126)	37%	7.9	6.9	7.2	6.9
ZDS (91)	27%	7.2	5.6	5.9	4.9
ZEOS (50)	26%	7.5	6.1	6.0	5.5
AVERAGE	30%	8.0	7.2	7.2	6.9

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VENDOR GRADES

Past and Present

	7/87	7/86	7/85	1/10/85	7/84	1/11/84	7/83
DESKTOP VENDORS							
Acer	D	C	C	B	C	D	D
ALR	C	D	B	D	C	E	C
Apple	B	B	B	B	B	B	C
AST	D	C	B	C	C	B	B
AT&T GIS	C	C*	D*	B*	E	E	E
Compaq	B	A	A	A	A	B	A
CompuAdd	B	C	D	B	C	C	A
CompuDyne	E	D	C	C	C	C	C
Dell	A	A	B	A	A	A	A
Digital	B	B	A	A	A	B	B
DTK	D	C	C	C	C	D	C
Epson	B	C	D	D	E	D	C
Everex	D	D	D	D	D	C	C
Gateway	B	B	B	A	A	A	A
Hewlett-Packard	B	A	A	A	A	A	B
IBM	A	A	A	A	A	B	B
Insight	B	D	B	B	B	N/A	N/A
Leading Edge	D	D	D	D	E	E	E
Micron	B	B	B	A	A	B	N/A
MidWest Micro	C	D	B	C	N/A	N/A	N/A
NCR	C	C*	D*	B*	C	C	C
NEC	C	B	B	C	C	D	B
Northgate	C	B	C	A	A	B	A

	7/87	7/86	7/85	1/10/85	7/84	1/11/84	7/83
DESKTOP VENDORS (continued)							
Packard Bell	D	D	C	E	E	E	E
Quantex	C	N/A	N/A	N/A	N/A	N/A	N/A
Tandy	D	C	D	E	E	E	E
Toshiba	B	N/A	N/A	N/A	N/A	N/A	N/A
Unisys	D	D	D	D	C	C	D
ZDS	D	D	D	E	E	E	E
ZEOS	B	C	C	A	A	A	A
NOTEBOOK VENDORS							
Acer	D	C	N/A	C	B	N/A	N/A
Apple	C	B	C	A	A	A	B
AST	D	D	D	D	D	D	B
Compaq	C	A	A	A	A	A	A
Dell	A	B	C	D	C	B	A
Gateway	C	B	B	A	B	A	C
Hewlett-Packard	B	B	B	A	B	N/A	N/A
IBM	B	B	B	A	A	B	A
Micron	B	N/A	N/A	N/A	N/A	N/A	N/A
NEC	B	B	B	B	B	D	D
Texas Instruments	D	D	C	A	A	C	C
Toshiba	B	A	A	B	B	B	A
WinBook	C	C	N/A	N/A	N/A	N/A	N/A
ZDS	D	D	D	E	E	E	E
ZEOS	D	D	C	D	B	C	A

* AT&T GIS and NCR were one company at the time of this survey

N/A—Not applicable. The vendor did not receive the 50 responses needed for inclusion in this survey

above average, but this does not count toward the grade.

In the final group are vendors whose former C and D grades have improved to a B. These companies are CompuAdd, Epson, Insight, and ZEOS, none of which has a market presence anymore.

FIVE DESKTOP C'S

To earn a C, a vendor has to achieve average scores on all four key measures. We have measured AT&T and NCR separately because they are once again separate companies. Both receive C's. (Last year, the combined AT&T/NCR received a C.)

Quantex Microsystems makes its debut on our survey with a C. This company has a particularly strong showing, with above-average scores on all three satisfaction measures but a below-average score for recent repairs.

After two years at a B, NEC drops

back to the C group as its recent-repairs score falls to average. Demographics may be at work here: 44 percent of our survey respondents say that they use their NEC machine at home. Home users traditionally include first-time users with limited computer knowledge. For those who need to call, NEC has increased its telephone-support personnel by 15

Midwest Micro has improved its recent-repairs score.

NINE D'S

A grade of D represents a combination of average and below-average scores. Acer America Corp., AST Computer, DTK Computer, and Tandy all drop from C to D. Acer is below average on technical-support satisfaction; all its other scores are average. But Acer is the one vendor with a less-than-C grade that still gets an above-average buy-again score. The company has added more staff and implemented dedicated phone numbers for segments of the market in an effort to improve its technical-support-satisfaction score.

On the other hand, an average score for recent repairs is the only thing keeping AST, Leading Edge, Packard Bell, Tandy, and Zenith Data Systems Direct from E's. All five garner below-average



FAST ANSWERS

Quantex, making its debut in the desktop category, quickly resolves its callers' problems an impressive 47 percent of the time, compared with the survey average of 31 percent.

percent over the past year. Northgate also drops from B to C.

Advanced Logic Research (ALR) and MidWest Micro have improved from last year's D's. ALR bettered its tech-support-satisfaction score, while

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READERS

RATE

Repairs and Technical Support

REPAIR EXPERIENCE
(among those needing repairs)TECH-SUPPORT EXPERIENCE
(among those using technical support)

- Significantly better than average
 Average
 Significantly worse than average

Time on hold (minutes) Problem solved over the phone Sent new part Fixed on-site PC was sent out for repair Got a new PC Got a run-around Tech was knowledgeable Tech tried everything to help Prompt resolution More than one call to resolve

DESKTOP PC VENDORS

Acer/Altos		17.4	22%	31%	24%	24%	7%	27%	31%	27%	25%	39%
ALR		13.9	31%	31%	31%	12%	4%	26%	42%	21%	42%	21%
Apple		12.1	32%	20%	32%	31%	5%	20%	42%	30%	35%	27%
AST		15.1	18%	24%	30%	28%	4%	26%	32%	28%	23%	33%
AT&T GIS		6.8	22%	18%	47%	18%	2%	17%	44%	29%	41%	29%
Compaq		13.0	23%	24%	36%	20%	6%	18%	40%	34%	30%	34%
CompuAdd		8.9	21%	16%	37%	11%	N/A	18%	36%	18%	36%	27%
CompuDyne		9.9	24%	20%	20%	42%	9%	27%	36%	15%	12%	42%
Dell		12.9	31%	32%	36%	10%	2%	13%	53%	42%	42%	27%
Digital		12.2	18%	23%	59%	13%	1%	18%	48%	23%	34%	23%
DTK		8.8	17%	19%	29%	25%	6%	17%	33%	20%	17%	37%
Epson		3.0	21%	7%	14%	36%	N/A	N/A	56%	11%	67%	11%
Everex		10.5	7%	29%	50%	18%	N/A	41%	32%	18%	18%	27%
Gateway		12.3	45%	49%	13%	9%	3%	14%	52%	46%	42%	30%
Hewlett-Packard		9.9	24%	28%	38%	13%	5%	16%	46%	41%	32%	27%
IBM		11.3	23%	24%	35%	21%	3%	16%	43%	37%	36%	27%
Insight		8.7	13%	38%	6%	38%	N/A	17%	44%	22%	33%	39%
Leading Edge		10.2	17%	25%	11%	33%	3%	17%	29%	13%	17%	29%
Micron		14.2	33%	54%	18%	11%	4%	11%	51%	42%	41%	30%
MidWest Micro		12.0	28%	33%	15%	20%	N/A	13%	56%	31%	33%	36%
NCR		15.1	19%	29%	38%	10%	5%	22%	22%	22%	11%	44%
NEC		14.9	20%	17%	32%	22%	8%	19%	36%	27%	25%	36%
Northgate		9.2	17%	28%	39%	22%	6%	10%	50%	25%	20%	20%
Packard Bell		22.0	28%	19%	17%	28%	6%	28%	36%	28%	23%	45%
Quantex		11.2	43%	41%	22%	11%	N/A	9%	43%	51%	47%	31%
Tandy		8.7	20%	17%	7%	53%	3%	19%	38%	19%	24%	29%
Toshiba		17.3	16%	18%	16%	36%	10%	18%	36%	28%	30%	27%
Unisys		10.1	18%	21%	57%	18%	21%	29%	24%	10%	38%	43%
ZDS		15.1	20%	22%	44%	22%	4%	24%	32%	24%	24%	44%
ZEOS		13.3	36%	27%	13%	22%	N/A	17%	49%	27%	33%	37%
AVERAGE		12.0	24%	26%	29%	23%	6%	20%	40%	27%	31%	32%

NOTEBOOK PC VENDORS

Acer/Altos		17.3	23%	19%	3%	42%	29%	32%	40%	28%	16%	32%
Apple		9.6	10%	23%	23%	53%	7%	N/A	63%	33%	58%	17%
AST		9.3	18%	22%	9%	56%	4%	16%	44%	34%	31%	25%
Compaq		13.5	13%	34%	16%	50%	8%	17%	39%	32%	35%	29%
Dell		12.2	20%	38%	22%	32%	9%	16%	45%	33%	37%	35%
Gateway		10.8	34%	38%	3%	29%	7%	11%	55%	52%	41%	28%
Hewlett-Packard		9.3	27%	41%	9%	41%	5%	21%	42%	33%	29%	25%
IBM		13.4	23%	26%	15%	47%	8%	23%	49%	37%	39%	33%
Micron		8.0	40%	20%	N/A	40%	4%	4%	68%	64%	64%	12%
NEC		10.6	17%	16%	10%	64%	2%	20%	41%	34%	38%	32%
Texas Instruments		14.3	12%	18%	2%	72%	13%	12%	54%	35%	31%	38%
Toshiba		16.3	13%	18%	15%	56%	5%	16%	38%	31%	28%	30%
WinBook		11.4	11%	15%	2%	67%	9%	15%	50%	40%	43%	18%
ZDS		10.5	12%	36%	16%	44%	12%	20%	35%	30%	15%	45%
ZEOS		10.5	31%	38%	23%	23%	8%	31%	38%	6%	13%	50%
AVERAGE		11.8	20%	27%	12%	48%	9%	18%	47%	35%	35%	30%

N/A—Not applicable. There were no responses for this question.

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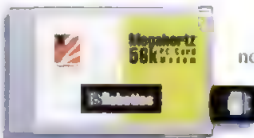


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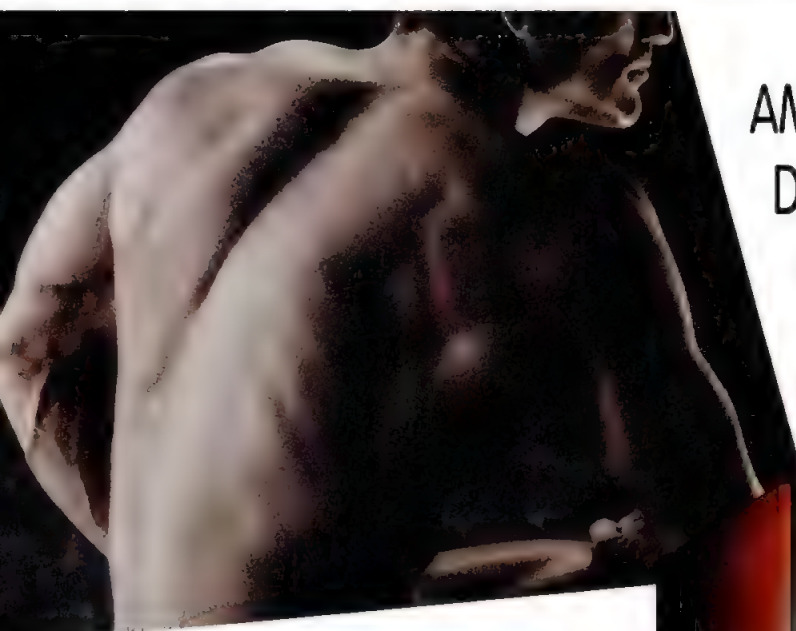
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scores on the three satisfaction measures.

Everex Systems and Unisys Corp. have been longtime D's. For both companies, the score for satisfaction with overall reliability is below average; all other scores are average.

AND ONE E

CompuDyne falls from a D to this year's only E. The company, which no longer manufactures PCs, receives below-average scores on all four measures.

NOTEBOOKS: LONELY AT THE TOP

The only A among notebook vendors is Dell. Dell's sweep—all above-average scores—is a major improvement from last year's B. At that time, Dell's only above-average score was

for satisfaction with reliability; all others were average.



BUY AGAIN?

The following vendors rank above average on the buy-again question: Dell, Gateway, Hewlett-Packard, IBM, Micron, and Toshiba for both desktops and notebooks. Acer/Altos, Digital, MidWest Micro, and NEC are thus ranked for desktops only.

FIVE NOTEBOOK B'S

After A's in two consecutive surveys, Toshiba drops to a B. Its only above-average score is for satisfaction with reliability. Many users have cited problems in getting repair parts quickly, but Toshiba says that parts availability is up significantly and that its defective-parts return rate is down 30 percent in the past year. HP and IBM earn their third B in a row, while NEC earns its fifth in a row.

Micron makes its debut in the notebook category and chalks up a strong B. The vendor gets above-average scores on all measures except recent repairs. But respondents who have used Micron's tech support are among the most satisfied in the survey: 68 percent said the tech-support rep was knowledgeable, 64 percent said the person was very helpful, and 64 percent said their problems were resolved promptly. These percentages were well above average.

MIDDLE OF THE PACK

Three notable vendors have dropped to C's by receiving average scores on all measures. Apple falls to a C because of an average recent-repairs score. Gateway earns a C because of an average score for satisfaction with technical support. Compaq earns a C after six consecutive A's: Its scores on all questions are average. Last December, Compaq announced a voluntary worldwide recall of certain AC adapters for the Armada 4100 because of the potential for electrical shock. The notebook itself was not recalled, so it is hard to say whether the recall had any negative effect on consumer satisfaction.

WinBook Computer Corp., appearing for the second time, receives its second C. The company garners average scores on all four measures.

FIVE D'S, NO E'S

Acer and Texas Instruments both receive a grade of D. For Acer, this is a fall from a C; TI remains steady at a D. This year, Acer acquired Texas Instruments' notebook business. (TI products will still be available under the

TI brand name for at least the next year.) Acer's rating for satisfaction with technical support has fallen from average to below average, so the addition of TI's service facility in Texas and the 100-plus staff members may help improve this situation.

For the second survey in a row, AST receives average scores on all measures except satisfaction with reliability, where its score is below average. ZDS does worse this year: It emerges below average on every measure except recent repairs. ZEOS has a D again.

There are no E's.

WHAT IT ALL MEANS

Buying a PC for your home or business can be confusing. We hope this survey helps you make your way through the forest of PC vendors to find a machine of your own. Toward this end, we will include the results of the four key measures in all of our PC reviews throughout the next year. □

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READERS RATE

SOFTWARE SUPPORT

In our sixth annual survey on software support and satisfaction, we asked readers to rate experiences with products in six categories, from operating systems to Web browsers.

SATISFACTION

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BY JOHN MORRIS

It happens every time a major office suite is released. You eagerly tear off the shrink-wrap, start the installation program, and then watch open-mouthed as the new suite chews up disk space as no program has before. Users like to complain about the "bloatware" phenomenon. But the truth is, when push comes to shove, most of us would choose more power over smaller applications in an Internet minute.

The better software gets, the more we want to do with it. So while software is becoming easier to use all the time, we're constantly demanding new features that make the programs more complex. To deliver a satisfying experience, a software package must strike a balance between new features and ease of use. And it must have the support behind it to get customers up and running.

Here at *PC Magazine*, we spend most of our time testing and writing about how products stack up against one another.

The purpose is to help you select the best product available for a particular job. Our annual Support and Satisfaction Survey is a little different. It's our chance to find out about users' experiences with the software they already have—in other words, to find out how satisfied readers are with the software they use every day.

SURVEY SAYS . . .

As in previous years, the results are generally positive. Most respondents give the products they use ratings of 8 or higher on a scale of 1 to 10 for satisfaction, and—with a few exceptions—give vendors solid ratings for technical support as well. Within each product category, results are more mixed and yield some interesting—in some cases even puzzling—trends.

Our sixth annual survey is based on the experiences of 7,531 subscribers (out of a random sample of 17,000). We asked them how they felt about products in six markets.



How We Surveyed

In February 1997 we mailed questionnaires to a randomly selected sample of 17,000 *PC Magazine* subscribers. The survey was closed for tabulation on April 14, at which time we had received a 50 percent response rate. Willard and Shullman, a research firm based in Greenwich, Connecticut, tabulated the survey.

The survey covered software applications, as well as desktop PCs and notebooks. The PC results are reported in "Readers Rate Service and Reliability," also in this issue.

Respondents indicated which software applications they had installed and used most often in each of six categories. Then, on a scale of 1 (worst) to 10 (best), they rated their overall satisfaction with each package and their satisfaction with technical support overall, as well as their satisfaction with a number of specific types of technical support. Respondents also rated their repair experiences and were asked how likely they would be to recommend the product. Only products that received at least 50 responses, which we considered the minimum amount of data neces-

sary to produce statistically reliable results, were included in the final tabulations.

To analyze the results, we focused on each question individually and calculated a score (an average of the ratings) for each software package, in each of the six categories. As a standard of

comparison, we calculated an overall average for each measure by adding up the individual manufacturer/package scores and dividing the total by the number of manufacturers or packages rated within that category.

In reporting our findings, we indicate how the product scores compare with the overall averages. These rankings were made using a *t-test*, a statistical procedure that takes into consideration the ratings, the amount of variation among

Though two products may receive the same numerical score, one may emerge as significantly better or worse than average while the other does not. Both Windows 95 and NT 3.x, for example, received scores of 8.3, but they garnered different rankings. This can happen because the rankings are compiled using a *t-test*, a statistical procedure that weighs not only the individual ratings but also the number of responses and the variation among them.

Significantly worse than average	satisfaction
OSs/ENVIRONMENTS	
DOS	8.8
Mac OS	8.2
Microsoft Windows 3.x	7.7
Microsoft Windows 95	8.3
Microsoft Windows NT 3.x	8.3
Microsoft Windows NT 4.0	8.6
OS/2 Warp	8.9
Unix	8.9
AVERAGE	8.4
DATABASES	
dBASE for Windows (Windows 95)	9.1
dBASE for Windows (Other Windows)	7.7
Lotus Approach (Windows 95)	9.1
Lotus Approach (Other Windows)	8.0
Microsoft Access (Windows 95)	8.4

The overall average is the total of all products' scores divided by the number of products in the category.

- ▲ Significantly better than average
- Average
- Significantly worse than average

them, and the number of ratings received. Therefore, it's possible for one product to appear in the average range while another with the same score emerges as significantly above average, or for a vendor with a lower score to be above average while one with a higher score is not.—Rachel Derby Teitler and Samantha J. Edwards

The questions can be divided into two basic categories: overall experience (which includes ratings for overall satisfaction and whether the user would recommend the product to another) and technical support.

This year, we've made a few changes. First, we dropped graphics programs from the survey to concentrate instead on more mainstream business productivity applications. We also added two new product categories that have arrived in the mainstream business arena: Web browsers and e-mail clients. In all, we covered 50 products including 8 different operating systems.

Of course, the software mar-

ket itself has changed, too. On the heels of the successful Microsoft Office 95, Microsoft Corp. released Microsoft Office 97 at the beginning of this year. Soon after, Lotus Development Corp. finally released a long-awaited upgrade to Lotus SmartSuite—though most likely too late to have had any

impact on this survey. Corel Corp. is poised to release a major upgrade to Corel WordPerfect Suite.

The situation is more complicated for Internet software. Both Microsoft and Netscape Communications Corp. are continually posting new versions of their browsers. Microsoft is finishing up a version of Microsoft Internet Explorer, which will be integrated into its forthcoming upgrade to Microsoft Windows 95. In the e-mail arena, Lotus has integrated its Lotus Notes groupware and the Internet with the release of Lotus Domino Server; the rollout may take some time, though, and probably has little impact on this survey.



OSs/ENVIRONMENTS

MICROSOFT WINDOWS 95
MICROSOFT WINDOWS NT 4.0

Microsoft Windows 95 scores higher than Windows 3.x in terms of overall satisfaction. Most Windows 95 and Windows NT 4.0 users would recommend the operating systems to another.

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THE STATE OF THE SOFTWARE

The rapid pace of software development makes it difficult to draw any lasting conclusions. But some general trends stand

out. First, *PC Magazine* readers have been quick to embrace 32-bit computing. The majority of readers who responded are using Windows 95—although a significant portion still use Windows 3.x. And they are running Microsoft applications as well.

The good news for Microsoft is that, in most cases, users give

PC Magazine readers—our sixth annual survey has put them to rest. Of all respondents, 62 percent say they now use Windows 95 as their operating system of choice.

The other 32-bit Windows operating system, Windows NT, has been somewhat slower to catch on among those who responded. Only 5 percent and 2 percent use Windows NT 4.0 and Windows

NT 3.x, respectively. About 23 percent are still using the 16-bit Windows 3.x.

Those who made the switch from Windows 3.x to Windows 95 are for the most part pleased. Windows 95 is rated higher in terms of overall satisfaction but not as high

as Windows NT 4.0 or DOS. One theory is that Windows NT 4.0 users are early adopters who look favorably on the technology, while DOS users are veterans who stick with what they are most comfortable with. The majority of Windows 95 and Windows NT 4.0 users would recommend their operating systems.

Results are more mixed when it comes to tech support. Windows 95 was designed to make computing easier, but not every-

resented by only about 1 percent of respondents. As in the past, these hardy souls have rallied to their environment by rating them as above average or average in most categories—even though 41 percent of OS/2 Warp users and 30 percent of Unix users say they needed tech support in the past year.

DATABASES

Microsoft Access is the database of choice among most *PC Magazine* readers surveyed. Of all respondents, 56 percent say they use Access. The rest of the market is a free-for-all, at least in our survey. The remaining databases—dBASE for Windows, Lotus Approach, Microsoft FoxPro for Windows, and Paradox—each have 5 percent or less when responses are divided among Windows 95 and other Windows operating systems.

Not only are most users choosing Access, they are also satisfied with the product. Access under Windows 95 receives the highest scores for both overall satisfaction and likelihood of recommending purchase. Other databases are generally close behind in terms of satisfaction, but fewer users say they would recommend them to another.

For technical support, scores are mostly average across the board. It's worth mentioning, however, that up to 21 percent of FoxPro's users say they needed technical support within the past year. (The average in this category is 15 percent.) And those FoxPro users say they spent from 9 to 14 minutes on hold.

Both Microsoft and Lotus released new, Internet-savvy versions of their databases in Office 97 and SmartSuite 97. Paradox, part of Corel's office suite, did not change in

Corel Office Professional 7 but will receive its first major overhaul with the upcoming release of WordPerfect Office 8.

E-MAIL

There is no longer any question concerning e-mail's role in our lives. It is as much a part of our work and daily activities as the word processor or spreadsheet—in many cases even more.

Our first attempt to survey readers



DATABASES

MICROSOFT ACCESS (OTHER WINDOWS)
MICROSOFT ACCESS (WINDOWS 95)

Not only are most users choosing Microsoft Access, they are also satisfied with the product. Access under Windows 95 receives the highest scores across the board.

its software impressive ratings for overall satisfaction. On the other hand, readers give Microsoft mixed ratings for technical support, including relatively poor ratings for written documentation. The exception is Web support, where Microsoft appears to be doing a fairly impressive job.

Judging from the number of responses we received regarding browsers and e-mail, the vast majority of *PC Magazine* readers have joined the online world. Netscape Navigator retains its edge in market share and satisfaction, according to the survey. The e-mail market, the variety of responses tells us, is more segmented.

Overall, readers give vendors solid ratings for technical support even though almost 18 percent say they needed tech support from the vendors in the past year and spent more than 11 minutes on hold, on the average. This suggests that users may be getting good technical support from other sources such as built-in help or the Web. Of course, other factors such as the cost of tech support may affect these ratings.

One conclusion seems very clear. Users are getting better software than ever in a wider range of categories. And for the most part, they like it.

OPERATING SYSTEMS

If there were any remaining doubts about the success of Windows 95—at least among



E-MAIL

EUDORA (WINDOWS 95)
MICROSOFT MAIL (WINDOWS 95)
NETSCAPE MAIL (WINDOWS)

Respondents say they are most satisfied with Eudora and Netscape Mail. Both Eudora and Netscape Mail also earn above-average scores for technical support.

one has found it to be a walk in the park: 28 percent of users say they required tech support. Despite strong scores for satisfaction, Microsoft's telephone support scores for Windows 95 are below average—a pattern we see in Microsoft products in other categories as well.

Most *PC Magazine* readers use some form of Windows, so it is no surprise that non-Windows operating systems (Mac OS, OS/2 Warp, and Unix) are each rep-

READERS **RATE****Software Satisfaction**

-  Significantly better than average
 Average
 Significantly worse than average

	Overall satisfaction	Likelihood to recommend
OSs/ENVIRONMENTS		
DOS	 8.8	 7.6
Mac OS	 8.2	 7.9
Microsoft Windows 3.x	 7.7	 7.0
Microsoft Windows 95	 8.3	 8.6
Microsoft Windows NT 3.x	 8.3	 8.0
Microsoft Windows NT 4.0	 8.6	 8.8
OS/2 Warp	 8.9	 8.3
Unix	 8.9	 8.1
AVERAGE	8.4	8.0

DATABASES

dBASE for Windows (Windows 95)	 8.1	 7.8
dBASE for Windows (Other Windows)	 7.7	 7.1
Lotus Approach (Windows 95)	 8.1	 8.0
Lotus Approach (Other Windows)	 8.0	 7.7
Microsoft Access (Windows 95)	 8.4	 8.5
Microsoft Access (Other Windows)	 8.1	 8.2
Microsoft FoxPro for Windows (Windows 95)	 8.3	 8.2
Microsoft FoxPro for Windows (Other Windows)	 8.1	 7.4
Paradox (Windows 95)	 8.2	 7.8
Paradox (Other Windows)	 7.6	 6.8
AVERAGE	8.1	7.7

E-MAIL

cc:Mail (Windows 95)	 7.8	 7.3
cc:Mail (Other Windows)	 7.1	 6.5
Eudora (Windows 95)	 8.7	 8.6
Eudora (Other Windows)	 8.2	 7.8
GroupWise (Windows 95)	 8.3	 7.6
GroupWise (Other Windows)	 7.6	 6.8
Lotus Notes (Windows 95)	 8.0	 7.8
Lotus Notes (Other Windows)	 7.8	 7.5
Microsoft Exchange (Windows 95)	 7.7	 7.6

Microsoft Exchange (Other Windows)	 7.9	 8.0
Microsoft Mail (Windows 95)	 8.2	 8.1
Microsoft Mail (Other Windows)	 7.4	 6.5
Netscape Mail (Windows 95)	 8.4	 8.5
Netscape Mail (Other Windows)	 8.0	 7.9
AVERAGE	7.9	7.6

SPREADSHEETS

Corel Quattro Pro (Windows 95)	 8.6	 8.4
Corel Quattro Pro (Other Windows)	 8.5	 8.0
Lotus 1-2-3 (Windows)	 8.4	 8.1
Lotus 1-2-3 (DOS)	 8.1	 6.9
Microsoft Excel (Windows 95)	 8.9	 8.9
Microsoft Excel (Other Windows)	 8.6	 8.6
AVERAGE	8.5	8.2

WEB BROWSERS

America Online Browser (Windows 95)	 7.1	 6.7
America Online Browser (Other Windows)	 6.7	 6.1
Microsoft Internet Explorer (Windows 95)	 8.4	 8.5
Microsoft Internet Explorer (Other Windows)	 7.6	 7.5
Netscape Navigator (Windows 95)	 8.8	 8.8
Netscape Navigator (Other Windows)	 8.5	 8.5
AVERAGE	7.8	7.7

WORD PROCESSORS

Ami Pro/Word Pro (Windows 95)	 8.3	 8.3
Ami Pro/Word Pro (Other Windows)	 8.2	 7.7
Corel WordPerfect (Windows 95)	 8.8	 8.7
Corel WordPerfect (Other Windows)	 8.6	 8.4
Corel WordPerfect (DOS)	 8.5	 7.9
Microsoft Word (Windows 95)	 8.8	 8.9
Microsoft Word (Other Windows)	 8.5	 8.6
AVERAGE	8.5	8.3

about the e-mail clients they use generates some mixed results. We see a wider range of ratings than in other product categories. And with the exception of Microsoft Exchange, programs that fare well under Windows 95 receive slightly lower scores when used with other Windows operating systems.

Considering that so many respondents are using Netscape Navigator as their Web browser, it's not surprising that 18 percent of those surveyed say they are also using its built-in mail client. Among Windows 95 users, another 14 percent say they use Exchange. Microsoft Mail—a catch-all category for the Exchange client, Internet Mail, and Outlook—and Eudora each take 13 to 14 percent of the market,

at least according to this survey.

But the big surprise here is Lotus Notes. Curiously, few respondents (5 percent altogether) say they use it, even though it holds a dominant position in the groupware market. Perhaps many are using Notes at work but do not report it because they use a different e-mail client with an ISP or online service at home.

None of the major groupware/messaging solutions—cc:Mail, GroupWise, Microsoft Exchange, or Notes—scores at the top in terms of overall satisfaction. In fact, Exchange for Windows 95's score falls near the bottom in this category.

Respondents say they are most satisfied with Eudora (a trial version is available from vendor Qualcomm's Web site) and

Netscape Mail. Users of both programs are also more likely to recommend them to another. More significantly, both Eudora and Netscape Mail also earn above-average scores for overall tech support under Windows 95.

The groupware segment also earns mediocre marks for tech support. For example, 21 percent of Exchange for Windows 95 users say they needed tech support in the past year. An even larger percentage of GroupWise users (22 percent) have needed tech support, but Notes users spent the most time on hold—an average of almost 20 minutes for those running Windows 95.

Most other clients receive average scores for technical support, with the ex-

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READERS **RATE****Technical Support**

-  Significantly better than average
 Average
 Significantly worse than average

Overall technical support Written documentation Tutorials Replacement of defective disks Support via the World Wide Web Support via online services Support via BBS Built-in help function % needing tech support in the past 12 months

OSs/ENVIRONMENTS

DOS	 8.0	 7.6	 6.8	 6.1	 6.4	 7.3	 7.6	 6.9	 8%
Mac OS	 7.5	 6.9	 7.4	 9.0	 8.0	 8.2	 9.0	 6.5	 24%
Microsoft Windows 3.x	 7.1	 6.4	 6.3	 7.3	 6.6	 6.3	 6.3	 6.2	 14%
Microsoft Windows 95	 7.3	 5.8	 6.6	 7.9	 7.4	 6.8	 6.6	 7.0	 28%
Microsoft Windows NT 3.x	 7.1	 6.7	 6.7	 8.8	 7.4	 7.2	 6.0	 6.4	 23%
Microsoft Windows NT 4.0	 7.0	 5.9	 5.9	 8.2	 7.4	 7.0	 7.5	 6.7	 34%
OS/2 Warp	 7.6	 7.0	 7.0	 7.9	 8.2	 8.0	 7.6	 7.4	 41%
Unix	 7.9	 7.0	 7.3	 8.5	 8.4	 6.3	 8.0	 7.3	 30%
AVERAGE	7.4	6.6	6.8	8.0	7.5	7.1	7.3	6.8	25%

DATABASES

dBASE for Windows (Windows 95)	 7.4	 7.0	 7.7	 8.8	 7.2	 7.5	 7.3	 7.5	 12%
dBASE for Windows (Other Windows)	 7.4	 7.2	 6.8	 7.8	 8.2	 5.7	 8.0	 6.6	 16%
Lotus Approach (Windows 95)	 8.0	 6.4	 6.8	 9.1	 6.5	 6.8	 7.5	 6.9	 16%
Lotus Approach (Other Windows)	 7.7	 7.2	 7.3	 8.5	 7.2	 6.9	 6.6	 7.2	 15%
Microsoft Access (Windows 95)	 7.6	 6.5	 6.9	 8.3	 7.7	 7.0	 7.2	 7.3	 14%
Microsoft Access (Other Windows)	 7.6	 7.0	 7.0	 8.0	 7.4	 6.9	 6.9	 7.2	 14%
Microsoft FoxPro for Windows (Windows 95)	 7.3	 7.2	 7.2	 9.2	 7.8	 7.2	 5.6	 7.3	 21%
Microsoft FoxPro for Windows (Other Windows)	 7.3	 7.0	 8.7	 7.5	 8.9	 7.3	 6.2	 7.0	 18%
Paradox (Windows 95)	 7.5	 7.1	 7.4	 8.4	 7.1	 7.5	 7.0	 7.4	 10%
Paradox (Other Windows)	 7.1	 6.7	 6.5	 7.9	 6.4	 5.7	 6.3	 6.4	 16%
AVERAGE	7.5	6.9	7.0	8.3	7.0	6.8	6.8	7.1	15%

E-MAIL

cc:Mail (Windows 95)	 7.7	 7.1	 7.0	 8.0	 7.1	 7.5	 6.9	 6.9	 21%
cc:Mail (Other Windows)	 6.5	 5.9	 5.7	 7.0	 5.7	 6.4	 4.6	 5.6	 21%
Eudora (Windows 95)	 8.0	 6.8	 6.3	 8.3	 7.9	 7.4	 7.3	 6.9	 11%
Eudora (Other Windows)	 7.5	 6.5	 6.2	 7.3	 7.5	 6.9	 6.5	 6.3	 10%
GroupWise (Windows 95)	 7.6	 6.5	 6.8	 7.0	 7.8	 6.2	 6.5	 6.0	 22%
GroupWise (Other Windows)	 6.7	 6.3	 6.4	 6.5	 6.7	 8.0	 8.4	 6.1	 22%
Lotus Notes (Windows 95)	 7.9	 6.0	 7.1	 8.3	 7.0	 8.0	 5.5	 6.7	 21%
Lotus Notes (Other Windows)	 7.5	 6.4	 7.0	 8.7	 7.5	 7.8	 9.0	 6.2	 15%
Microsoft Exchange (Windows 95)	 7.4	 5.2	 5.9	 8.5	 7.0	 6.6	 6.5	 6.4	 21%
Microsoft Exchange (Other Windows)	 7.8	 6.4	 6.8	 9.0	 7.3	 7.4	 8.0	 7.8	 15%
Microsoft Mail (Windows 95)	 7.7	 6.1	 6.7	 8.4	 7.5	 7.3	 6.3	 6.8	 12%
Microsoft Mail (Other Windows)	 7.0	 5.9	 6.0	 6.8	 6.7	 6.8	 5.4	 6.1	 19%
Netscape Mail (Windows 95)	 7.8	 6.3	 6.8	 7.4	 8.0	 6.9	 7.6	 6.8	 11%
Netscape Mail (Other Windows)	 7.6	 6.3	 5.8	 8.2	 7.8	 6.8	 6.4	 6.2	 16%
AVERAGE	7.5	6.3	6.4	7.8	7.2	7.1	6.6	6.5	17%

READERS RATE

Technical Support (continued)

- Significantly better than average
 ○ Average
 ● Significantly worse than average

	Overall technical support	Written documentation	Tutorials	Replacement of defective disks	Support via the World Wide Web	Support via online services	Support via BBS	Built-in help function	% needing tech support in the past 12 months
America Online Browser (Other Windows)	● 6.4	● 5.1	○ 5.9	○ 6.5	● 5.9	● 6.0	● 5.0	● 6.0	● 30%
Microsoft Internet Explorer (Windows 95)	● 7.6	○ 5.8	○ 6.5	○ 8.5	● 7.9	○ 7.1	○ 6.8	● 6.8	▲ 17%
Microsoft Internet Explorer (Other Windows)	○ 7.0	○ 6.0	○ 6.5	○ 6.0	○ 7.2	○ 6.6	○ 7.2	○ 6.5	▲ 13%
Netscape Navigator (Windows 95)	● 7.9	● 6.3	○ 6.7	○ 7.9	● 8.1	● 7.3	● 7.4	● 6.9	▲ 16%
Netscape Navigator (Other Windows)	● 7.6	● 6.4	○ 6.4	○ 8.2	● 7.9	○ 7.2	○ 6.3	○ 6.4	▲ 16%
AVERAGE	7.2	5.9	6.4	7.4	7.2	6.7	6.3	6.5	20%

WORD PROCESSORS

Ami Pro/Word Pro (Windows 95)	○ 7.7	○ 7.0	○ 7.2	○ 8.5	○ 7.0	○ 7.9	○ 7.6	○ 7.3	○ 23%
Ami Pro/Word Pro (Other Windows)	○ 7.8	○ 7.5	○ 6.9	● 9.5	○ 7.2	○ 7.2	○ 6.9	○ 7.1	○ 16%
Corel WordPerfect (Windows 95)	● 8.1	○ 7.2	○ 7.4	○ 7.9	○ 7.3	○ 7.2	○ 6.4	● 7.7	● 24%
Corel WordPerfect (Other Windows)	○ 7.9	● 7.5	● 7.5	○ 8.3	○ 7.0	○ 7.1	○ 7.4	○ 7.5	○ 18%
Corel WordPerfect (DOS)	○ 7.8	● 7.8	○ 6.7	○ 8.8	○ 6.5	○ 8.5	○ 7.0	○ 7.2	○ 17%
Microsoft Word (Windows 95)	○ 7.7	● 6.8	○ 7.2	○ 8.3	● 7.6	○ 6.9	○ 7.1	● 7.6	▲ 15%
Microsoft Word (Other Windows)	● 7.5	● 7.0	○ 7.0	○ 7.9	○ 7.3	○ 6.8	○ 6.6	○ 7.3	▲ 15%
AVERAGE	7.8	7.2	7.1	8.6	7.1	7.1	7.0	7.4	18%

ception of cc:Mail on non-Windows 95 platforms, with a score near the bottom in many categories.

SPREADSHEETS

Most everyone is now buying productivity software in suites, so it's no surprise that Microsoft is as dominant in the spreadsheet category as it is in the word processor and database segments. Microsoft Office 95 and the more recently released Office 97 have taken a decisive lead in the suite competition.

In the case of spreadsheets, more than 50 percent of those surveyed are using Microsoft Excel under Windows 95, and another 25 percent are using the program under other Windows operating systems, leaving Corel Quattro Pro and Lotus 1-2-3 to fight over the rest. Significantly, not only is Excel used by the majority of respondents, it also receives the highest scores for both overall satisfaction and the likelihood of recommending the product to another. The story changes somewhat when you look at the technical-support categories, in which Excel receives mostly average scores, with below-average scores for telephone tech support. Excel users say they spent almost 12 minutes

on hold, on the average.

Lotus popularized the spreadsheet, and on our survey, 1-2-3 retains a significant slice of the market—even though the 32-bit version wasn't released until earlier this year. Of those surveyed, 10 percent are using 1-2-3 under Windows and 3 percent continue to use the DOS version. That leaves Quattro Pro with less than 10 percent of the Windows market.

Despite their loyalty to DOS spreadsheets, 1-2-3 for DOS

have required the least amount of tech support in the past 12 months. Only 6 percent say they needed some assistance—most likely because DOS hold-outs are well versed in their programs. Quattro Pro earns generally average scores for tech support.

WEB BROWSERS

It used to be that Web browsers were fairly straightforward packages. Nowadays, things are a little more complicated. Browsers have integrated e-mail and news readers, HTML authoring tools, and workgroup features. Soon, they'll even make a bid to replace your desktop environment.

It's no wonder, therefore, that users have strong feelings about browsers. In this, our first Support and Satisfaction Survey covering Web browsers, users report a wide range of experiences, depending on the product.

The main competitors in this space are Microsoft Internet Explorer and Netscape Navigator. Although Internet Explorer has been gaining ground rapidly (Microsoft gives it away), Navigator retains the largest share of the market—a fact reflected in our survey responses. About 54 percent of respondents report using Navigator as



WEB BROWSERS

MICROSOFT INTERNET EXPLORER (WINDOWS 95)

NETSCAPE NAVIGATOR (OTHER WINDOWS)

NETSCAPE NAVIGATOR (WINDOWS 95)

Although Microsoft Internet Explorer has been gaining ground rapidly, Netscape Navigator retains the largest share of the market—a fact reflected in our survey responses.

users are the least satisfied with their products. This may be an indication that many have simply been waiting for the long-overdue release of the 32-bit version with SmartSuite 97 before making the switch to Windows.

Not surprisingly, 1-2-3 for DOS users

READERS

RATE

Telephone Technical Support

- Significantly better than average
 ○ Average
 ● Significantly worse than average

Satisfaction with telephone technical support

Number of minutes on hold

OSs/ENVIRONMENTS

DOS	○ 6.9	○ 8.9
Mac OS	○ 7.3	○ 8.2
Microsoft Windows 3.x	● 6.1	○ 12.4
Microsoft Windows 95	● 6.4	● 13.9
Microsoft Windows NT 3.x	○ 7.0	○ 10.3
Microsoft Windows NT 4.0	○ 6.4	○ 11.2
OS/2 Warp	○ 7.2	○ 9.6
Unix	○ 7.3	○ 18.3
AVERAGE	6.8	11.6

DATABASES

dBASE for Windows (Windows 95)	○ 7.3	○ 8.8
dBASE for Windows (Other Windows)	○ 7.2	○ 9.1
Lotus Approach (Windows 95)	○ 7.1	○ 12.1
Lotus Approach (Other Windows)	○ 7.0	○ 12.7
Microsoft Access (Windows 95)	○ 6.7	○ 10.8
Microsoft Access (Other Windows)	○ 7.0	○ 12.0
Microsoft FoxPro for Windows (Windows 95)	○ 6.5	○ 9.4
Microsoft FoxPro for Windows (Other Windows)	● 5.8	○ 13.9
Paradox (Windows 95)	○ 7.5	○ 15.7
Paradox (Other Windows)	○ 6.7	○ 11.7
AVERAGE	6.9	11.6

E-MAIL

cc:Mail (Windows 95)	○ 7.3	○ 9.2
cc:Mail (Other Windows)	● 5.9	○ 13.1
Eudora (Windows 95)	○ 7.1	○ 8.6
Eudora (Other Windows)	○ 7.2	● 7.9
Groupwise (Windows 95)	○ 7.4	○ 12.7
Groupwise (Other Windows)	○ 7.3	○ 12.3
Lotus Notes (Windows 95)	○ 6.5	○ 19.3
Lotus Notes (Other Windows)	○ 7.5	○ 15.4
Microsoft Exchange (Windows 95)	● 6.4	○ 13.2

Satisfaction with telephone technical support

Number of minutes on hold

Microsoft Exchange (Other Windows)	○ 7.8	○ 16.0
Microsoft Mail (Windows 95)	○ 6.9	○ 9.6
Microsoft Mail (Other Windows)	○ 6.8	○ 10.4
Netscape Mail (Windows 95)	○ 7.5	○ 9.5
Netscape Mail (Other Windows)	○ 7.0	○ 15.9
AVERAGE	7.0	12.4

SPREADSHEETS

Corel Quattro Pro (Windows 95)	○ 8.0	○ 9.0
Corel Quattro Pro (Other Windows)	○ 7.7	○ 10.6
Lotus 1-2-3 (Windows)	○ 7.5	○ 8.3
Lotus 1-2-3 (DOS)	○ 7.1	○ 11.8
Microsoft Excel (Windows 95)	● 6.9	○ 11.8
Microsoft Excel (Other Windows)	● 6.9	○ 11.6
AVERAGE	7.3	10.5

WEB BROWSERS

America Online Browser (Windows 95)	● 5.3	● 20.6
America Online Browser (Other Windows)	● 5.5	○ 16.8
Microsoft Internet Explorer (Windows 95)	○ 6.6	○ 10.8
Microsoft Internet Explorer (Other Windows)	○ 6.5	○ 8.4
Netscape Navigator (Windows 95)	● 7.5	● 10.1
Netscape Navigator (Other Windows)	● 7.1	● 10.0
AVERAGE	6.4	12.8

WORD PROCESSORS

Ami Pro/Word Pro (Windows 95)	○ 7.4	○ 11.1
Ami Pro/Word Pro (Other Windows)	○ 7.6	● 6.6
Corel WordPerfect (Windows 95)	● 8.0	○ 10.0
Corel WordPerfect (Other Windows)	○ 7.7	○ 9.8
Corel WordPerfect (DOS)	○ 7.7	○ 11.2
Microsoft Word (Windows 95)	● 6.8	○ 12.1
Microsoft Word (Other Windows)	● 6.8	○ 11.6
AVERAGE	7.4	10.3

their Web browser. Another 25 percent say they use Internet Explorer under Windows 95.

Netscape has made a concerted effort to develop Navigator for a wide variety of platforms, while Microsoft has, until very recently, focused much of its innovations on Windows 95. Perhaps that is why only 3 percent of non-Windows 95 respondents use Internet Explorer, compared with 17 percent for Navigator. The remaining 16 percent say they use America Online, under either Windows 95 or other Windows operating systems, for Web browsing.

No matter which Windows operating

system they use, Navigator users report the highest overall satisfaction. Internet Explorer for Windows 95 also garners above-average scores for satisfaction.

In terms of technical support, both Microsoft and Netscape receive average or above-average scores across the board, with Navigator receiving slightly better scores in some cases. Users of both browsers spent about 10 minutes on hold when they needed help.

It seems clear that the browser market has been reduced to a two-horse race. The other browser in our survey, America Online's, receives worse-than-average scores in most categories. CompuServe and the

Microsoft Network use versions of Internet Explorer.

Taking the measure of Web browsers can be difficult, because they change so rapidly. A prerelease version of Navigator 4.0, dubbed Communicator, is available from Netscape's site. Internet Explorer 4.0 will be a part of Microsoft's next operating system, code-named Memphis, which is due around the end of the year.

WORD PROCESSORS

In the past year, Microsoft has cemented its lead in the market for word processors—and for office suites in general. Of

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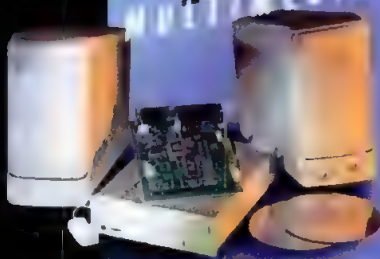


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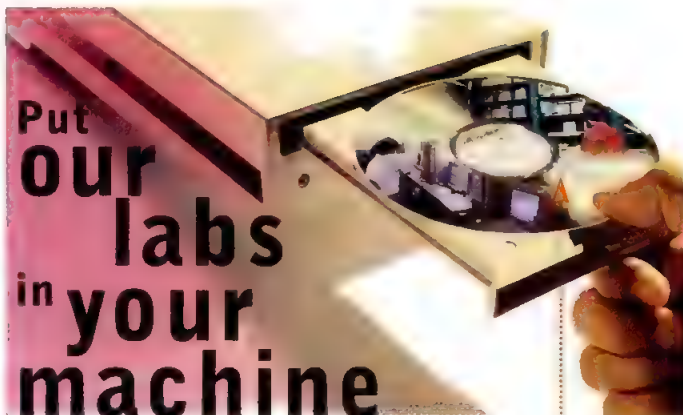
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THE PERFECT PC

those surveyed, 66 percent report using Microsoft Word, and 45 percent are using it under Windows 95. Of the remaining 30 percent, WordPerfect for Windows takes the lion's share, while only 4 percent report using Ami Pro/Word Pro.

While it remains the most popular word processor by far, Word still evokes some ambivalent feelings among users. In terms of overall satisfaction, it scores at the top, and the vast majority of users on any Windows operating system would recommend it to another user. However, Word still receives lackluster scores when it comes to customer support, especially on non-Windows 95 platforms. Word users on Windows 95 and other Windows operating systems say they spent the longest time on hold (12.1 and 11.6 minutes, respectively). The good news is that only 15 percent of Word users have actually required technical support within the last 12 months—possibly an indication the software is doing an impressive job of assisting users right out of the box. One notable exception is written documentation, for which Word scores lowest.

The other big story here is WordPerfect. In terms of overall satisfaction, WordPerfect's scores are even slightly better than Word's. But WordPerfect also receives better scores overall for technical support—a hallmark of WordPerfect that current owner Corel has restored. WordPerfect for Windows 95, for example, garners the highest overall score for technical support of any word processor. Perhaps that's because the same users have had lots of opportunities to test it out: 24 percent of WordPerfect for Windows 95 users have needed technical support, which Corel provides free of charge, in the past year. Interestingly, WordPerfect for DOS retains a loyal following, though few would recommend it to someone else—an indication that its time may have passed.

With a handful of exceptions, Ami Pro/Word Pro receives average scores across the board. But Lotus is still playing catch-up in the office suite space: SmartSuite 97 finally shipped earlier this year. So stay tuned. □



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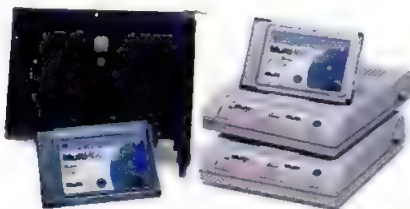
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THE PC MAGAZINE

As we at *PC Magazine* reckon its history, the personal computing industry is well into its third decade. More than 20 years have passed since the birth of industry giants Apple Computer, Intel, and Microsoft. Their quick rise to prominence in desktop hardware and software paced the early years of personal computing. Today, they and a handful of later entries—Cisco, Compaq, Hewlett-Packard, IBM, and Novell, to name a few—stand among the giants of the industry. After two decades of unprecedented growth, this group of high-tech companies is setting the pace not just for the personal computing industry but for much of the world's economy as well. In a business as fast-paced as personal computing, growth has remained the one constant. Rapid

product innovation, intense competition, and unrelenting merger activity pressure even the most established compa-

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Which companies are

the true leaders in per-

sonal computing? Sometimes mar-

ket share and annual revenues don't

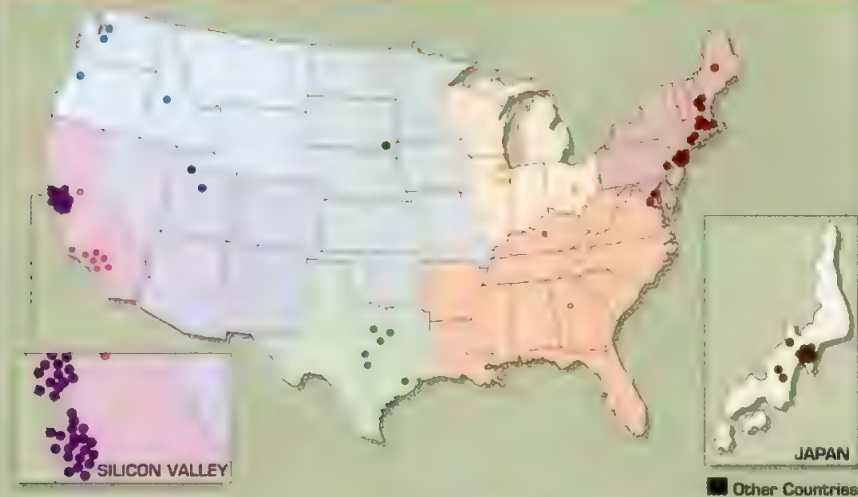
tell the entire story. In this list,

PC Magazine makes the call.

MOST INFLUENTIAL COMPANIES

BY JAKE KIRCHNER

Mapping Out PC Magazine's Top 100 Companies



- | | | | |
|----|--|-----|--|
| 1 | Microsoft Corp. | 51 | Seiko Epson Corp., JAPAN |
| 2 | Intel Corp. | 52 | Xerox Corp. |
| 3 | IBM Corp. | 53 | Imega Corp. |
| 4 | Netscape Communications Corp. | 54 | Dialogic Corp. |
| 5 | Sun Microsystems Inc. | 55 | Samsung/AST Research, KOREA |
| 6 | Compaq Computer Corp. | 56 | Logitech International SA, SWITZERLAND |
| 7 | Hewlett-Packard Co. | 57 | Matsushita Electric Industrial, JAPAN |
| 8 | Cisco Systems Inc. | 58 | National Semiconductor Corp. |
| 9 | Oracle Corp. | 59 | PC Connection Inc. |
| 10 | Toshiba Corp., JAPAN | 60 | Sharp Corp., JAPAN |
| 11 | Dell Computer Corp. | 61 | Fujitsu Ltd., JAPAN |
| 12 | Apple Computer Inc. | 62 | Hitachi Ltd., JAPAN |
| 13 | Adobe Systems Inc. | 63 | NEC Corp., JAPAN |
| 14 | Gateway 2000 Inc. | 64 | Borland International Inc. |
| 15 | Novell Inc. | 65 | MetaTools Inc. |
| 16 | 3Com Corp. | 66 | Matrox Graphics Inc., CANADA |
| 17 | Gorel Corp., CANADA | 67 | Sybase Inc. |
| 18 | America Online Inc. | 68 | MCI Communications Corp. |
| 19 | PointCast Inc. | | Motorola Inc. |
| 20 | Packard Bell NEC Inc. | 70 | Hayes Microcomputer Products Inc. |
| 21 | Softbank Corp., JAPAN | 71 | Adaptec Inc. |
| 22 | Intuit Inc. | 72 | Philips Electronics NV, NETHERLANDS |
| 23 | Digital Equipment Corp. | 73 | Western Digital Corp. |
| 24 | Silicon Graphics Inc. | 74 | Activision Inc. |
| 25 | Symantec Corp. | 75 | Cirrus Logic Inc. |
| | U.S. Robotics Corp. | 76 | Cabletron Systems |
| 27 | Canon Inc., JAPAN | 77 | ATI Technologies Inc., CANADA |
| 28 | Progressive Networks Inc. | 78 | Aimtech Corp. |
| 29 | Macromedia Inc. | | Computer Discount Warehouse |
| 30 | id Software Inc. | 80 | Quarterdeck Corp. |
| 31 | Seagate Technology Inc. | | CompuServe Inc. |
| 32 | Advanced Micro Devices Inc. | 82 | ideallab! |
| 33 | S3 Inc. | 83 | DeLorme Mapping Co. |
| 34 | Acer Group, TAIWAN | 84 | Informix Software Inc. |
| 35 | Marimba Inc. | 85 | Lexmark International Inc. |
| 36 | McAfee Associates Inc. | 86 | Madge Networks Inc. |
| 37 | Micron Technology Inc. | 87 | Broderbund Software Inc. |
| 38 | Autodesk Inc. | 88 | Phoenix Technologies Ltd. |
| 39 | Bay Networks Inc. | 89 | Power Computing Corp. |
| 40 | Creative Technology Ltd., SINGAPORE | 90 | Be Inc. |
| 41 | GT Interactive Software Corp. | 91 | Number Nine Visual Technologies Inc. |
| 42 | Ascend Communications Inc. | 92 | Eastman Kodak Co. |
| 43 | Sony Corp., JAPAN | 93 | The Santa Cruz Operation Inc. |
| 44 | Gyrix Corp. | 94 | ViewSonic Corp. |
| 45 | Diamond Multimedia Systems Inc. | 95 | Rockwell Semiconductor Systems |
| 46 | CUC International Inc. | 96 | SAP AG, GERMANY |
| 47 | Computer Associates International Inc. | 97 | The Learning Company Inc. |
| 48 | AT&T Corp. | 98 | Tektronix Inc. |
| 49 | Texas Instruments Inc. | 99 | Yahoo! Inc. |
| 50 | International Data Group | 100 | Firefly Network Inc. |

nies in this sector, making it as challenging to project the future course of the industry as it is entertaining to chronicle the daily developments. The sudden emergence of Oracle Corp. and Sun Microsystems as trendsetters after years of being the sleeping giants of corporate information technology proves yet again the power of one hot product (Java) or one ground-breaking idea (the network computer). And the chart-busting rise of Netscape demonstrates convincingly that this industry can still convulse when a small group of people combine innovation with a healthy purse of venture capital.

For most of these years, *PC Magazine* has chronicled the rise and fall of players large and small. During the past three years, we have produced an annual list of the leading companies in PCs, peripherals, software, and networking. But in a time of change, we realized, identifying the companies that are likely to lead the personal computing industry in the coming years is just as important as noting the firms that have prospered in the past year.

Our effort to create this year's *PC Magazine* list of leading companies started (rather than ended) with a mere enumeration of the sales leaders. Beginning our deliberations with the latest market data from several established industry watchers—in particular, Computer Intelligence, Dataquest, and Soft•letter—we expanded our search to target not just the richest or best-known companies but the most influential. Over a space of two months' time, approximately 3 dozen members of the editorial staff and our contributing editors participated in a special Lotus Notes discussion database, supplemented by hundreds of e-mail messages back and forth. As we debated the importance of the top several hundred companies, we struggled to narrow the list to 100.

Many companies on our ultimate list are the ones you would expect to see. But we think you'll also find some surprises in a few of those listed. And judging from our own debate, the relative rankings of the group as a whole will be more than a little controversial. Given that our own discussions were intense, generating at times considerable disagreement, we expect to elicit some strong responses from our readers. And we expect those to influence our determinations next year.

The PC Magazine 100

There are 100 companies behind the perfect PC—100 companies that make the personal computer what it is and what it will be.

1 Microsoft Corp.



The software empire that was built on a C:\ prompt, Microsoft has done for software what McDonald's did for the hamburger. Since its introduction of Windows a decade ago, Microsoft has shipped more than 100 million copies of the world's pre-eminent desktop operating system. The company has been almost as dominant in the desktop applications arena. Its business productivity suite, Office 97, has sold more than 8 million units since its introduction in January and is believed to be the software giant's single most profitable product. A little more than a year ago, Microsoft abruptly shifted its strategy by announcing plans to embrace and extend Internet technology. By offering its Internet Explorer browser for free, Microsoft has rapidly gained ground against rival Netscape on the Web front. Microsoft's next OS release, Memphis, will be tightly integrated with Internet Explorer. Microsoft has begun expanding beyond traditional software markets by developing innovative programming for its online service The Microsoft Network, partnering with NBC to establish a new television network, and most recently purchasing start-up WebTV Networks. Microsoft was founded in 1975 by Paul G. Allen and CEO William H. Gates III, who set out to write a version of BASIC, which the company later licensed to IBM for its first personal computers. Products now sold in



more than 50 countries and available in 30 languages brought the company 1996 revenues of \$8.67 billion for the fiscal year that ended June 30.

www.microsoft.com

2 Intel Corp.



For more than a decade, a single company has governed the microprocessor market. After introducing the microprocessor in 1971 and providing the CPU for IBM's inaugural PC ten years later, Intel still supplies the core technology for more than 90 percent of all personal computers worldwide. Yet such a market share merely begins to illustrate the company's influence. Living by the aphorism "Only the paranoid survive," CEO Andy Grove and company have come to dictate the designs not only of processors but of processor sockets, chip sets, caches, and even motherboards. With \$20.85 billion in 1996 revenues, Intel has furthered its hegemony with new processor introductions in both the consumer and corporate markets: the Pentium Processor with MMX Technology and the Pentium II. The eponymous law of cofounder Gordon Moore—an assertion that processing power doubles every 18 months—has held true for 25 years and is expected to carry Intel through the millennium.

www.intel.com

3 IBM Corp.



For years the most respected office-technology company, IBM has seen its prominence fade in recent years. In 1981, its PC triggered a seminal industry expansion but ultimately proved a greater success for the more flexible Intel, Microsoft, and clone makers. As profits sagged, the company shed its non-computer-related businesses; formed alliances with Apple, Cyrix, and Motorola; and acquired Lotus and Tivoli Systems. Now emerging from a ten-year slump thanks to intranet-related ventures, its ThinkPad line of notebook computers, and the AS/400, IBM remains formidable under CEO Louis Gerstner, with 1996 revenues of \$75.95 billion. Also

a major player in software, IBM sells more software than even Microsoft and has a new emphasis on Java and electronic commerce.

www.ibm.com

4 Netscape Communications Corp.



The company that brought the World Wide Web to millions of desktops, Netscape was successful to the tune of \$346.2 million in 1996 revenues, producing products for all aspects of the online world including the Enterprise Web Server, the Netscape Merchant System for electronic commerce, and Collabra Share for group conferencing. This year, the fast-rising internet software company expects to conquer another new frontier—the desktop operating environment—with Netcaster, which will be integrated with Communicator as the company focuses on groupware and extranets with cross-platform, Internet-centric applications. CEO James Barksdale hopes that Netscape's open-standards philosophy will be as popular in corporate intranets as it has been with Web surfers and developers.

www.netscape.com

5 Sun Microsystems Inc.



Sun Microsystems says the network is the computer—and the company is working hard to prove it. This industry heavyweight, with annual revenues of \$7.09 billion for the fiscal year that ended June 30, 1996, now focuses on the Java programming language. Sun's primary business, however, is graphical workstations, and it has a 32 percent share of the international market and annual growth rates of 15 to 20 percent as a result. Though skeptics question the viability of the networking strategy, few can deny CEO Scott McNealy's persuasive prowess, whether as a speechmaker or as a TV guest on "Charlie Rose." Sun's formation of its Javasoft division highlights the company's commitment to make Java an established software platform.

www.sun.com

Picking Number One amid Natural Disasters and Alien Invasions

The long, free-flowing debate inside PC Magazine that produced the list of the 100 most influential companies was child's play compared with the challenge of anointing one company as the most influential. A consensus quickly emerged that Microsoft and Intel should hold the top two positions. After that, the debate became intense and at times a little strange, as demonstrated in these excerpts from our Lotus Notes discussion database.

FRANK J. DERFLER, JR., senior networking editor: If Mount St. Helens blew its stack and buried Redmond tomorrow, would we have a viable software industry six weeks later? Answer: You betcha! But if Portland slipped into the sea, would we have a viable supplier of processors and motherboards? We could have a great industry without Microsoft, but we could not have the same success without Intel.

DON WILLMOTT, executive editor: Well, I'll go home and consult the *Book of Revelations* to see what Frank knows that I don't, but in the meantime, I still believe that Microsoft has more influence in the world, if only because

- it controls (so far) the way everyone's desktop looks;
- my mom knows who Bill Gates is but doesn't know who Andy Grove is. That's influence!

S. JAE YANG, project leader: Consider the following chains of events.

SCENARIO A

- The entire staff of Microsoft gets abducted by aliens.
- Windows 95 CDs go for \$500 on black markets.
- Intel asks Borland, IBM, Netscape, and Symantec to develop successors to Windows 95 and Windows NT right away. Netscape ships first, but its OS, Commander, is full of bugs. Because of internal inefficiencies, IBM ships OS/97 a year late.
- Apple announces it will license its hardware to any system vendors and will become a software company.
- Over two years, Motorola quadruples its run rate, while Intel's sales drop 90 percent.
- Intel lays off 80 percent of its employees worldwide. Andy Grove resigns.

SCENARIO B

- The Portland and Santa Clara Intel facilities are vaporized by an alien's plasma beam. Surviving Intel engineers find jobs with AMD.
- AMD rakes in big money, but the PC market shrinks initially as new home-computer buyers flock to cheaper Apple machines. Corporate America waits.
- Fearing too much meddling from the bigger guys, Microsoft endorses AMD as the next Intel by announcing plans to ship Memphis on the x86 platform first.
- AMD hires Andy Grove, and all is right with the world.

The key here is that the corporate world may wait for Microsoft to find a new platform, but it won't wait for Intel to find a new OS.

MICHAEL E. RYAN, associate editor: If Microsoft made a public statement that tomorrow the sky will be red with little floating yellow polka dots, a disturbing number of people would actually believe it. If Intel made a similar statement, most people would say, "Shut up; make me a faster processor."

MICHAEL J. MILLER, editor-in-chief: I agree that Intel is important, and perhaps harder to replace, but when Microsoft says, "Jump," an amazing number of people in the industry ask, "How high?" When Intel says, "Jump," everyone looks to make sure Microsoft says it's okay, then jumps.



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6 Compaq Computer Corp.

Since its founding in 1982, Compaq Computer has been the model of a successful PC vendor. It was one of the first to release an IBM-compatible PC and introduced one of the first portables in 1983. Although the recession of the early 1990s brought a corporate shake-up, Compaq quickly recovered under CEO Eckhard Pfeiffer. In 1994, the Houston-based company became the number-one U.S. personal computer company, outpacing both Apple and IBM. With 1996 revenues of \$18.11 billion, Compaq now aims to become one of the top three computer companies worldwide by the year 2000. With its dominance and popularity in the server market, Compaq is looking for revenue growth outside of PCs and recently introduced a PC/TV with SGS Thomson.

www.compaq.com

7 Hewlett-Packard Co.

Founded in 1938 and initially run out of a Palo Alto garage, Hewlett-Packard was one of the first Silicon Valley start-ups. A pioneer in electronic testing equipment, it released the first hand-held scientific calculator. With revenues of \$38.42 billion for the fiscal year that ended October 31, 1996, HP is currently a market leader in computer printers and a top player in the PC and workstation markets. Under CEO Lewis Platt, it spends much of its substantial R & D budget on new information-sharing technologies. HP is also working with Intel on Merced, the next-generation x86 processor architecture. A leader in both laser and ink jet printers, HP has one weak area—notebook PCs—for which it has set the lofty goal of being number one within the next five years.

www.hp.com

8 Cisco Systems Inc.

The acquisition of several smaller companies (most recently StrataCom) has augmented the dominance of Cisco Systems

lately. Cisco remains market leader of the networking industry, with revenues of \$4.10 billion for the fiscal year that ended July 28, 1996. Its family of routers, switches, and corporate networking solutions is based on Cisco Internetwork Operating System (Cisco IOS), which is an integrated suite of network services. Cisco has a strong hold on the Internet as well, with more than 80 percent of the backbone Internet routers made by the company. CEO John Chambers looks ahead to multilayer switching with the development of CiscoFusion, an architecture for integrating switching devices into shared-media networks.

www.cisco.com

9 Oracle Corp.

Oracle Corp. is already the world's number-one seller of relational database software, a version of which runs on everything from laptops to mainframes. Its software commands 44 percent of the worldwide database market. For the fiscal year that ended May 31, 1996, Oracle brought in \$4.22 billion in revenues. CEO Lawrence Ellison sees the future of Oracle in the NC—a low-cost network computer that stores information on a network instead of desktops—for which his company has set the standard. Oracle won't manufacture computers using the Network Computer Reference Profile but plans to supply the software to run the NC.

www.oracle.com

10 Toshiba Corp.

The Tokyo Shibaura Electric Co., or Toshiba, was formed by the merger of two large Japanese electronics firms in 1939. It rose to prominence in the 1980s when it started manufacturing semiconductor chips. Toshiba introduced the first 1-megabit DRAM chip in 1985 and initiated a popular line of laptop PCs in 1986. Joint ventures with a number of European and U.S. companies have since helped it broaden the range of its retail business and research. With annual revenues of \$48.30 billion for the fiscal year that ended March 31, 1996, and led by CEO Taizo Nishimuro, Toshiba is the number-

one laptop seller and one of the companies behind the DVD standard. It is one of the companies best poised to capitalize on the convergence of PCs and consumer electronics.

www.toshiba.com

11 Dell Computer Corp.

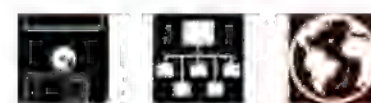
The brainchild of founder and CEO Michael Dell, the world's number-one direct marketer of PCs posted \$7.76 billion in revenues for the fiscal year that ended February 2, 1997. With the Internet's most resourceful computer supermarket, Dell's configure-it-yourself Web site rings up sales of \$1 million a day. Now that Dell has introduced Dell Financial Services, customers cannot only buy their PCs direct, they can finance them that way as well. This fourth-largest U.S. PC maker plans to bring the same service to the international market, where it expects its business leasing program to grow rapidly.

www.dell.com

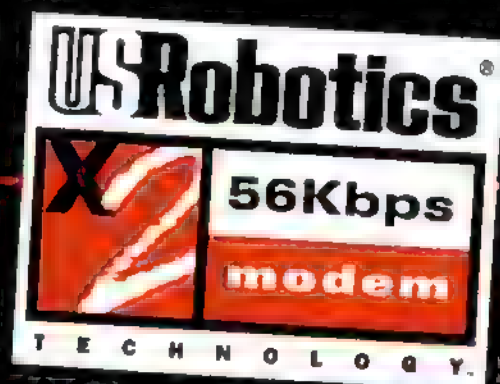
12 Apple Computer Inc.

Remembered fondly for its history of innovation and creativity, Apple has had a tough time in the past few years. Despite a second-quarter loss of \$708 million, Apple remains a major player in the PC industry, with revenues of \$9.83 billion for the fiscal year that ended September 27, 1996. The company last year acquired NeXT, which returned cofounder Steve Jobs to the fold and bolstered prospects for Apple's next-generation operating system, Rhapsody. CEO Gil Amelio hopes to build on Apple's legacy of invention, concentrating on both the Internet and multimedia to return the company to a role of industry leadership.

www.apple.com

13 Adobe Systems Inc.

A leader in the field of desktop publishing, Adobe Systems took in revenues of \$786.6 million for the fiscal year that ended November 29, 1996. Adobe continued inno-



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30-DAY
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GUARANTEE



* All 3.5 products are 3.5" high, 5.25" wide, and 1.5" deep. The 3.5" high, 5.25" wide, and 1.5" deep products are 3.5" high, 5.25" wide, and 1.5" deep. The 3.5" high, 5.25" wide, and 1.5" deep products are 3.5" high, 5.25" wide, and 1.5" deep.

** An 3.5" floppy disk is 3.5" high, 5.25" wide, and 1.5" deep. The 3.5" high, 5.25" wide, and 1.5" deep products are 3.5" high, 5.25" wide, and 1.5" deep.

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To prove just how committed we are to x2, we're introducing "x2 Delivers," a special program that will show you why buying an x2 modem now makes so much sense:

CONNECT NOW **in all 50 states and Canada**

Right now, you can call an ISP and get x2 service, no matter where you live.

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After the new 56K ITU-T standard is approved, we'll upgrade your U.S. Robotics x2 Technology 56K modem — absolutely free.

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Now, for a limited time, when you purchase a U.S. Robotics x2 Technology 56K modem, we'll pay for one month of free service from any x2-capable Internet service provider — up to \$25.

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We're confident you'll be completely satisfied with your new x2 modem. If not, return it within thirty days of purchase — no questions asked.

See the back cover for complete details of the x2 Delivers program.

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The ability to connect now in all 50 states and Canada. A free month of service. A free upgrade to the ITU-T standard. A 30-day money-back guarantee. It couldn't be any easier. For more information, visit www.usr.com/x2now, or call 1-800-525-USR1 to find a provider near you with live x2 service.

Download nearly twice as fast as 28.8 modems with the company that connects more people to the Internet than any other. If extra speed is what you're looking for, remember one thing: x2 delivers.



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FREE UPGRADE TO 56K ITU-T STANDARD
FREE MONTH OF INTERNET SERVICE (UP TO \$25)
30-DAY MONEY-BACK GUARANTEE

Buy any Sportster or Courier 56K modem with x2 Technology between June 1 and September 15, 1997 and get one month of Internet service plus upgrade to 56K ITU-T standard, **FREE**. And if you're not satisfied after 30 days you can return the modem for a full refund.

To get your free month of Internet service with an x2-capable Internet service provider, just complete and return the card below.

Then, you'll also be registered for the free upgrade. After the ITU-T standard for 56K modems is approved, we'll upgrade your U.S. Robotics x2 Technology 56K modem, free of charge. Since every x2 modem is equipped with Flash ROM, we expect the upgrade to be as simple as a software download from the Internet. If it's not, we'll replace your modem with one that does meet the new standard — free of charge. Register your modem, and when the 56K standard is approved by the ITU-T, we will notify you how and when to get your free upgrade. Approval is expected sometime in early 1998.

And again, if you're not satisfied with your U.S. Robotics x2 Technology 56K modem, simply return it within 30 days of purchase, along with dated receipt, to the store or mail order reseller where you bought it for a full refund.

1. Guaranteed upgrade valid for all currently available Sportster 56K Faxmodems (Models 1784, 1785, 1786, 1787 and 1789) and Courier 56K Faxmodems (Models 1867, 1868 and 1869). This offer valid in the U.S. and Canada only.



FREE MONTH OF INTERNET SERVICE

**Get 1 month of Internet service from any ISP
live now with x2 Technology (up to \$25).**

To get your free month of Internet service:

1. Buy any Sportster or Courier listed below between June 1 and September 15, 1997.
2. Call 1-800-525-USR1 or visit www.usr.com/x2now to find out if your current ISP has live x2 service now. If not, choose one of the x2-capable ISPs listed there.
3. Fill in requested information on this card.
4. Enclose this completed form with a copy of your dated modem receipt, original UPC bar code symbol and serial number from the modem package (see samples below) and proof of your x2 ISP monthly fee (credit card bill or monthly statement) and mail to:

U.S. Robotics, x2 Delivers, PO Box 8061, Young America, MN 55551-8061

Any questions regarding this program, please call 1-800-127-2107.

(Please print all information clearly.)

Name _____

Address _____

City _____

State/Prov _____

ZIP/POST _____

Country _____

Phone _____

E-mail Address _____

Retailer / Mail Order where modem purchased _____

ISP Name _____

Monthly fee _____

Internet service offer valid with purchase of Sportster or Courier 56K Faxmodem with x2 Technology (Models 1784, 1785, 1786, 1787 and 1789) and Courier 56K Faxmodems (Models 1867, 1868 and 1869) between June 1 and September 15, 1997. Register your modem to get the free upgrade to 56K ITU-T standard. The upgrade is free of charge. Since every x2 modem is equipped with Flash ROM, we expect the upgrade to be as simple as a software download from the Internet. If it's not, we'll replace your modem with one that does meet the new standard — free of charge. Register your modem, and when the 56K standard is approved by the ITU-T, we will notify you how and when to get your free upgrade. Approval is expected sometime in early 1998. And again, if you're not satisfied with your U.S. Robotics x2 Technology 56K modem, simply return it within 30 days of purchase, along with dated receipt, to the store or mail order reseller where you bought it for a full refund.

vating with new versions of Acrobat, the standard in rich-document publishing; Photoshop, the premier photo design and production application; PageMill, a WYSIWYG HTML editor; and its PostScript page-description language for printers, which recently got an Internet-savvy Version 3.0. The year 1996 saw Adobe, helmed by CEO John E. Warnock, placing more emphasis on Windows-based versions of many of its products in a field long dominated by the Macintosh.

www.adobe.com

14 Gateway 2000 Inc.



Founded as an alternative to the higher prices, more limited offerings, and poor support often found in retail PC outlets, Gateway has gone on to become the second leading direct-marketing PC company. Located in South Dakota, it has successfully combined an oddball bovine sensibility in its ads with a devotion to customer satisfaction. CEO Theodore Waitt led the company to a 37 percent annual sales increase, with 1996 revenues of \$5.04 billion.

www.gw2k.com

15 Novell Inc.



Since Joe Marengi was promoted to president of Novell in 1996, the network software leader has turned its attentions to the Internet. The third quarter saw the rollout of IntranetWare, which supports Web access and Java. The newest changes at Novell include the March 18 appointment of former Sun chief technology officer Eric Schmidt as CEO. Even with Windows NT gaining popularity, Novell continues to hold the majority of the installed base with its network operating system, NetWare. Novell ended its fiscal year on October 26, 1996, with revenues of \$1.37 billion.

www.novell.com

16 3Com Corp.



Computer, communication, and compatibility are the three *coms* that make up the

second-largest manufacturer of network hardware in the world. Led by CEO Eric Benhamou, 3Com is known for its LAN and WAN families of products. 3Com that ended its fiscal year on May 31, 1996, with \$2.33 billion in revenues. Technologies currently under development at 3Com's Technology Development Center include virtual networking, Gigabit Ethernet, and multimedia over networks. 3Com recently announced a definitive agreement to merge with U.S. Robotics in a deal valued at \$6.6 billion.

www.3com.com

17 Corel Corp.



Corel and CEO Michael Cowpland have been battling Microsoft in the software-suite arena since acquiring the bulk of WordPerfect Corp.'s product line in 1996. In addition to creating customized suite products for the medical, legal, and engineering professions, Corel continues to develop new versions of its WordPerfect Suite for DOS and Windows 3.1. With \$334.2 million in revenues for the fiscal year that ended November 30, 1996, Corel also has product lines aimed at the home and Internet markets.

www.corel.com

18 America Online Inc.



Responsible for bringing the Internet to the masses, America Online has become the world's largest provider of online services, with revenues of \$1.09 billion for the fiscal year that ended June 30, 1996. Facing growing competition from smaller Internet service providers, AOL introduced its \$19.95 flat-rate billing plan last year. But along with increased use came lawsuits from customers unable to log on to their accounts. AOL's future may lie in its ability to provide original content that other, smaller ISPs can't. To this end, CEO Stephen Case has hired former NBC executive Brandon Tartikoff to head its new entertainment division and help make AOL the must-see service provider of the 1990s.

www.aol.com

19 PointCast Inc.



The company that introduced millions to push technology, PointCast was founded in 1992 to deliver last-minute news and information via the Internet. The company launched the PointCast Network in 1996, turning PC desktops and screen savers into streams of news and information. The privately held company has since added the corporate intranet to its horizon with the PointCast I-Server, which lets internal networks broadcast content within corporations. CEO Christopher R. Hassett has steered PointCast successfully through its first broadcast year, forging alliances with a dream list of content partners as well as with Microsoft for integration with its Internet Explorer Active Desktop.

www.pointcast.com

20 Packard Bell NEC Inc.



Packard Bell NEC is part of a global alliance of Packard Bell, NEC, and Groupe Bull of France. NEC now owns about 35 percent of the company, and Groupe Bull about 20 percent. Under CEO Beny Alagem, Packard Bell NEC is the second-largest U.S. PC maker in terms of units shipped, with estimated 1996 revenues of \$7 billion.

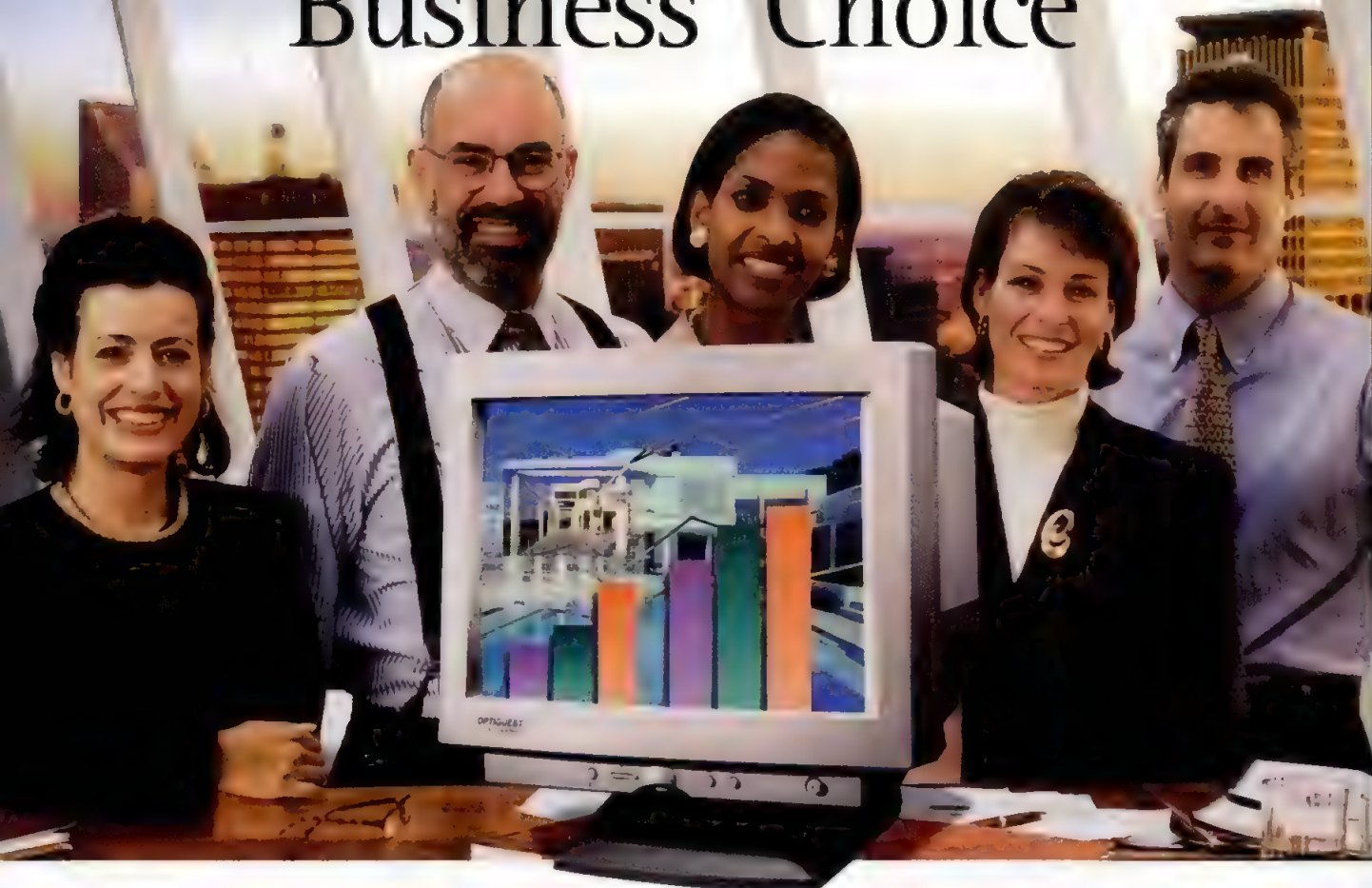
www.packardbell.com

21 Softbank Corp.



Founded in Japan in 1981, this global juggernaut pulled in 1997 revenues of \$2.85 billion for the fiscal year that ended March 31. Under CEO Masayoshi Son, Softbank is the number-one computer publisher and software distributor in Japan. Its Ziff-Davis Expos and the Interface Group, which runs Comdex, give it a strong position in computer trade shows. With its purchase of Ziff-Davis (the company that publishes *PC Magazine* and owns market research firm Computer Intelligence), Softbank became one of the world's largest publishers of computer periodicals. Its broad focus includes stakes in memory-

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Editors' Choice

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Whether your company needs a large screen monitor for desktop publishing, graphics design, spreadsheets or multiple Windows® applications, one choice stands out: the Optiquest V775. This powerful 17" (16.0" viewable) monitor offers the specs and features you'd expect from much higher priced monitors, including an ultra fine 0.26mm dot pitch, Invar shadow mask, resolutions up to 1,600 x 1,280, intuitive OnView® controls, ARAG® screen treatment, Super Contrast screen and more. The payoff is luxuriously rich colors and sharp text for both PC and Mac® systems. You'll be impressed with the Optiquest V775 – the editors of PC Magazine certainly were.

OPTIQUEST MONITORS							
	Q100	V775	V773	Q71	V655	Q53	V641
Size/Viewable	20"/18.4"	17"/16.0"	17"/15.8"	17"/16.0"	15"/13.8"	15"/13.8"	14"/13.2"
Dot Pitch	0.28mm	0.26mm	0.26mm	0.28mm	0.28mm	0.28mm	0.28mm
Max. Resolution	1600 x 1280	1600 x 1280	1280 x 1024	1280 x 1024	1280 x 1024	1280 x 1024	1024 x 768
Horiz. Scan Freq.	30-85kHz	30-85kHz	30-69kHz	30-70kHz	30-65kHz	30-70kHz	31.5/37.5-48.4kHz
MSRP	\$1,149	\$699	\$599	\$559	\$339	\$319	\$229

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www.softbank.co.jp

22 Intuit Inc.



By making financial chores such as balancing your checkbook and paying your taxes a little bit easier, Intuit earned revenues of \$538.6 million for the fiscal year that ended July 31, 1996. The maker of Quicken, the number-one personal finance software, has captured 80 percent of the overall market. CEO William Campbell sees Intuit's future, however, on the Internet, where he believes everything from tax forms to bill payment will become a paper-free operation, powered by Intuit software.

www.intuit.com

23 Digital Equipment Corp.



Defying the industry standard of 32-bit microprocessors, Digital managed to bring in \$14.56 billion in revenues for the fiscal year that ended June 30, 1996, in part on the strength of its 64-bit Alpha processor. With the imminent introduction of Millicent, a commerce system that will allow monetary transactions as small as fractions of a cent, CEO Robert Palmer is hoping the minicomputer maker has found the key to making the Internet a profitable enterprise.

www.dec.com

24 Silicon Graphics Inc.



Founded in 1982, Silicon Graphics is a leading supplier of high-performance computing systems ranging from low-end desktop workstations to servers and high-end supercomputers. Last year, SGI completed its merger with Cray Research to cement its position as one of the leading names in high-end computing. SGI has carried its expertise in 3-D graphics to the Internet as a pioneer and proponent of the Virtual Reality Modeling Language (VRML) on the

Web. Under CEO Edward R. McCracken, SGI posted \$2.92 billion in revenues for the fiscal year that ended June 30, 1996.

www.sgi.com

25 Symantec Corp.



When Symantec purchased Peter Norton Computing in 1990, it became the market leader in PC utilities. Indispensable programs such as Norton AntiVirus and Norton Utilities pushed Symantec's revenues up to \$472.2 million for the fiscal year that ended March 28, 1997. This year saw the end of a five-year dispute with Borland International over trade secrets, with both sides dropping their claims. Now that it has sold its system- and network-management business to Hewlett-Packard Co., Symantec plans to grow through continued acquisitions, the introduction of brand-new flavors of utilities, remote communications software, and the pro-

duction of a leading Java compiler.

www.symantec.com

26 U.S. Robotics Corp.



With a new class of high-speed modems and the first successful personal digital assistant, U.S. Robotics Corp. is establishing itself as a trend-setting company in different means of transferring data. On the personal side of keeping data on the move, its Palm Pilot brought PDAs out of the exclusive sphere of gadget-heads and toward the mainstream market. In the world of high-speed data transfer, its modem line was recently enhanced with the company's new x2 technology, which is expected to let modems transmit data at up to 56 Kbps. With these and other telecommunications products, the Illinois-based firm took in \$1.98 billion in revenues for the fiscal year that ended September 29, 1996, under the direction

Top 10 PC Software Vendors

By 1996 revenue

	Revenue (millions)	Market share (%)
1 Microsoft	\$9,435	52
2 Novell	\$1,312	7
3 Adobe	\$787	4
4 Intuit	\$580	3
5 Autodesk	\$497	3
6 Symantec	\$459	3
7 GT Interactive	\$367	2
8 Netscape	\$346	2
9 Learning Co.	\$343	2
10 SCO	\$217	1

Total \$17,999 million

Other \$3,656 million (20%)

Source: Soft*letter.

Top 10 PC and Portable Vendors

By 1996 U.S. unit shipment estimates

	Shipments (thousands)	Market share (%)
1 Compaq	3,347	13
2 Packard Bell NEC	2,223	8
3 IBM	2,199	8
4 Dell	1,894	7
5 Apple	1,658	6
6 Gateway 2000	1,635	6
7 HP	1,334	5
8 Toshiba	1,270	5
9 Acer	906	3
10 NEC	799	3

Total 26,784 thousand

Other 9,519 thousand (36%)

Source: Computer Intelligence, April 1997.

of CEO Casey Cowell. It recently announced a definitive agreement to merge with 3Com Corp., in the largest deal in telecommunications-industry history.

www.usf.com

27 Canon Inc.



Through its subsidiary, Canon Computer Systems, the Japanese camera and electronics maker is one of the world's largest manufacturers of computer printers, supplying the engines for HP laser printers as well. In January, Canon announced that it would abandon the U.S. PC and laptop market because of slim sales, leaving the company with its high-quality ink jet color printers, scanners, and digital cameras. CEO Yasuhiro Tsubota leads the division, which had approximately \$1.2 billion in 1996 revenues, while Canon CEO Fujio Mitarai led the parent company to \$22.05 billion in 1996 revenues.

www.ccsi.canon.com

28 Progressive Networks Inc.



Since its 1995 launch of RealAudio, Progressive Networks continues to lead the pack in developing streaming media over the Internet. Its family of Web technologies includes RealAudio and RealVideo. Recently, CEO Rob Glaser has stretched the Real metaphor further by developing the RealMedia Architecture (RMA)—client/server APIs for third-party streaming multimedia application creation—and the Real Time Streaming Protocol (RTSP) in a partnership with Netscape. Progressive Networks' strategy of innovation based on conventional resources has won the support of such players as Adobe and Sun and has helped bring in estimated 1996 revenues of \$25 million.

www.realaudio.com

29 Macromedia Inc.



Continually delivering the standard in desktop multimedia products, Macromedia brought in \$107.4 million in rev-

enues for the fiscal year that ended March 31, 1997, with products such as Authorware, Director, and Freehand. The company has successfully moved into the world of Web multimedia with Shockwave, one of the most downloaded plug-ins for Web browsers this year. Shockwave, which allows movies from Macromedia's multimedia program Director to be deployed on the Web, was instrumental in bringing life and movement to the World Wide Web. CEO John C. Colligan hopes to continue Macromedia's multimedia streak with Final Cut, which will bring powerful video editing and production to PC desktops.

www.macromedia.com

30 id Software Inc.



This privately held company's success lies in the use of nontraditional marketing strategies to get the word out on the street. "Try before you buy" is one innovation in which only part of a game is released on CD or, more commonly, over the Internet. Superior graphics and riveting scenarios make id's games difficult to resist, as shown by the popularity of Quake and DOOM, which has spawned several novels and plans for a movie, interactive television programming, and virtual-reality entertainment centers. Lead by CEO Todd Hollenshead, the company had estimated 1996 revenues of \$16 million.

www.idsoftware.com

31 Seagate Technology Inc.



Founded in 1979, storage giant Seagate Technology shipped its 100 millionth hard disk in November 1996. CEO Alan F. Shugart guided the company to \$8.58 billion in revenues for the fiscal year that ended June 30, 1996. Seagate stands as the world's largest independent disk drive and components company, holding the industry's greatest revenues share and unit volume. Its software arm, Seagate Software, produces storage support and enhancement programs. With a recent strategic partnership with WebTV, Seagate is now preparing to enter the new

marketplace of Internet storage.

www.seagate.com

32 Advanced Micro Devices Inc.



Although AMD tried to raise its visibility among consumers with a flashy TV ad campaign, the real battle is for the attention of PC makers. With 1996 revenues of \$1.95 billion, AMD is dwarfed by Intel. Still, CEO W.J. Sanders is banking that his company's newest chip, the K6, will help boost AMD's sales. Following an aggressive expansion of its manufacturing capacity—the company now has plants in China, Malaysia, Thailand, and the U.S., a joint venture with Fujitsu in Japan, and a plant under construction in Germany—AMD may yet become a household name like its big rival.

www.amd.com

33 S3 Inc.



S3 is a leader in the field of graphics and multimedia accelerator chips, posting 1996 revenues of \$465.4 million. The company sells its products to such companies as Compaq, Dell, and Diamond Multimedia, which use the chips in their systems and add-in cards. Piloted by CEO Gary Johnson, S3 is forging ahead with its new motto "Sight, Sound, Speed" by introducing an MMX-enabled chip as well as chips designed to accelerate DVD, MPEG-2, and videoconferencing.

www.s3.com

34 Acer Group



Taiwan's largest computer maker bought Texas Instruments' notebook computer business in February and bills itself as the world's fourth-largest PC maker. Increasing revenues to \$5.82 billion in 1996, CEO Stan Shih continues to expand the company, which was founded in 1976. Acer now operates factories in Malaysia, the Netherlands, the Philippines, Taiwan, and the U.S. The company also has formed business alliances with companies that in-

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clude Hitachi and 3Com, the latter for development of digital consumer products such as PC-ready televisions and digital video disk (DVD) players.

www.acer.com

35 Marimba Inc.



Marimba was founded only last year to develop products for the creation and deployment of network-managed applications and multimedia experiences both within intranets and across the Internet. The brainchild of four of the original members of Sun Microsystems' Java team, including CEO Kim Polese, Marimba has found no shortage of strategic allies for its promising push technology. Shortly after celebrating its first birthday, the privately held software company announced that its Castanet software would be bundled with Netscape Communicator, the Internet suite that contains the latest version of Navigator.

www.marimba.com

36 McAfee Associates Inc.



A leader in the field of antivirus and security software, with 1996 revenues of \$181.1 million, McAfee is proof that software can be successfully marketed through shareware channels. Under the direction of CEO William Larson, the company has broadened its scope by purchasing Vycor Corp., a vendor of client/server help-desk products. Following an unsuccessful attempt to acquire Cheyenne Software in 1996, McAfee focused on expanding its presence internationally by opening an office in Japan and by acquiring Jade KK, a Japanese antivirus software developer.

www.mcafee.com

37 Micron Technology Inc.



The brainchild of Idaho twins Ward and Joe Parkinson, Micron Technology is one of America's most successful semiconductor manufacturers and direct PC vendors. It achieved profitability during

the 1980s, thanks to a hefty investment from Idaho potato tycoon J.R. (Mr. Spud) Simplot. Although last year's collapse of semiconductor prices caused a 50 percent drop in Micron's stock value, the company, now led by CEO Joseph Daltoso, continues to increase sales, with \$3.65 billion for the fiscal year that ended August 31, 1996 (the PC division, Micron Electronics, pulled in \$1.76 billion of that total).

www.micron.com

38 Autodesk Inc.



Autodesk is known primarily for its design-automation products. Computer-aided design software, such as its flagship product AutoCAD, accounted for the majority of the company's \$496.7 million in sales for the fiscal year that ended January 31, 1997. The company has pushed even further into this market with its recent acquisition of Softdesk, a supplier of architecture and engineering software. Under the direction of CEO Carol Bartz, the company has also continued its expansion into mapping technology and interior design software by acquiring Argus Technologies and Creative Imaging Technologies. In 1996 a new division, Kinetix, was created to develop multimedia and Internet design products such as 3D Studio MAX.

www.autodesk.com

39 Bay Networks Inc.



Compatibility and standards are keys to Bay Networks' vision. Along with IBM and 3Com, Bay Networks was a co-founder of the Networking Interoperability Alliance to develop a set of open networking standards. The company's line of routers, switches, hubs, and network technologies is based on Bay Networks' Switched Internetworking Services, which integrates switched internetworking with advanced network management, control, and security. The company, now run by CEO David L. House, posted \$2.06 billion in revenues in the fiscal year that ended June 30, 1996.

www.baynetworks.com

40 Creative Technology Ltd.



Having turned in \$1.31 billion of revenues for the fiscal year that ended June 30, 1996, Creative Technology is one of the powerhouse multimedia companies in the PC world. Headquartered in Singapore by CEO Sim Wong Hoo, the company is better known in America through its wholly owned subsidiary Creative Labs. Maker of the ubiquitous Sound Blaster sound cards, Creative Technology has its hands on the entire spectrum of multimedia accessories, from sound and video cards to PC speaker systems. While holding 70 percent of the sound board market, Creative Technology is also expanding into new areas, such as DVD upgrade kits.

www.creaf.com

41 GT Interactive Software Corp.



With 1996 revenues of \$365.5 million, GT bills itself as the number-two publisher of game software, in addition to distributing programs published by other companies. GT is starting to shift its focus away from distribution, particularly after its top retail customer decided to buy directly from some companies. GT said the shift will let it concentrate on its more profitable software-publishing business, which includes such titles as Duke Nukem. GT's recently acquired Humongous Entertainment unit also plans to develop TV, movie, and home video programming based on its video game characters.

www.gtinteractive.com

42 Ascend Communications Inc.



Finishing 1996 with \$549.3 million in revenues, Ascend dominated the Internet service provider market. In the last quarter alone, more than 300 ISPs picked Ascend products for Internet-access solutions. Ascend is also known for its family of WAN-access switches and its use of dynamic bandwidth in its remote-access products. Its acquisition of Stony Brook



The new high-performance HP OmniBook 5700 features:

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Software in December should lead CEO Mory Ejabat and company toward innovations in management and monitoring applications for ISDN and remote access.
www.ascend.com

43 Sony Corp.



Consumer electronics giant Sony introduced the first transistor radio to Japan in 1955 and in 1996 posted \$43.33 billion in revenues for the fiscal year that ended March 31. Under CEO Norio Ohga, it is a market leader in computer monitors and manufactures memory chips, CD-ROM drives, and a myriad of other computer peripherals. Relying on the success of its computer components and name recognition, Sony entered the PC market in 1996 with mixed results. Expecting a convergence of consumer and computer electronics, Sony recently introduced its WebTV Internet Terminal. Along with Philips, Sony has developed the DVD.

www.sony.com

44 Cyrix Corp.



One of the Davids fighting Goliath chip-maker Intel, Cyrix makes microprocessors designed for entry-level PCs. The company, which designs and markets its chips but doesn't actually produce them, had 1996 revenues of \$183.8 million—just a fraction of the \$15.4 billion worldwide processor market. The company is developing the M2 chip to beat Intel's Pentium. Cyrix has been without a permanent CEO since December and is being led by chairman Jay Sweat until a new chief is named.

www.cyrix.com

45 Diamond Multimedia Systems Inc.



A long-time player in the world of graphics cards, Diamond Multimedia has broadened its scope in recent years. In addition to its line of 2-D and 3-D graphics accelerator cards, Diamond has used corporate acquisition to enter new markets.

With the purchase of modem-maker Supra Corp., Diamond took a place in the telecommunications and networking market. Despite a competitive market, CEO William J. Shroeder was able to improve the company's 1996 revenues to \$598.1 million from \$467.6 million in 1995.

www.diamondmm.com

46 CUC International Inc.



The consumer services company bought software publishers Davidson & Associates and Sierra On-Line last year for about \$2 billion, bolstering a software unit that also includes Blizzard Entertainment and Knowledge Adventure. CUC took in most of its \$2.35 billion in revenues for the year that ended January 31, 1997, on sales of consumer items and services to its more than 66 million members, with discounts on products ranging from video games to vacation getaways. Though little of that business is currently online, CUC plans to start selling on the Web, where CEO Walter Forbes expects half of CUC's customers to be in about seven years.

www.cuc.com

47 Computer Associates International Inc.



Computer Associates has gained influence in large part by acquiring smaller firms specializing in business databases. Recent purchases include Legent in 1995 and Cheyenne Software in 1996. Led by longtime CEO Charles Wang, the company expected slightly more than \$4 billion in revenues for the fiscal year 1997. Its major clients include defense contractors and other Fortune 500 companies.

www.cai.com

48 AT&T Corp.



Ma Bell made its first foray into the PC world in the 1980s, offering a line of desktop machines that didn't exactly catch fire with the public. Last year, the telecom-

munications giant spun off its previously acquired computer unit, NCR Corp., as well as its research and development unit, Lucent Technologies. AT&T now boasts being the world's second-largest Internet service provider, serving 750,000 subscribers with its WorldNet service. Still, its products and online services accounted for only about 7 percent of its \$52.18 billion in 1996 revenues. CEO Robert Allen said he's optimistic about strong growth in the online arena as the company fights off increased competition in telephone services.

www.att.com

49 Texas Instruments Inc.



The U.S. electronics giant is taking dramatic measures to return to profitability, after an 80 percent drop last year in prices for the DRAM chips it makes led to 1996 earnings losses. CEO Thomas Engibous promptly sold off two businesses—defense electronics and notebook computers—which together produced about 13 percent of the company's 1995 revenues. TI, which was an early pioneer in semiconductor technology and affordable calculators, posted 1996 revenues of \$9.94 billion. Engibous, who called 1997 a transition year, is looking to growth through the recovery in chip prices and new technologies such as digital imaging.

www.ti.com

50 International Data Group

International Data Group is one of the world's largest publishers of computer-related books, newspapers, and magazines. Its 275 magazines and newspapers and 450 books are published in 75 countries. IDG also produces 90 computer-related expositions in 35 countries, and its research arm, International Data Corp., provides computer-industry research and analysis through 51 offices in 43 countries. Founded in 1964 by CEO Patrick McGovern, the privately held company had estimated 1996 revenues of \$1.7 billion. Its titles include *Computerworld*, *Macworld*, and *PC World* and the popular line of "... For Dummies" books.

www.idg.com



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*Optional accessory available at additional price. †Projected U.S. street price. Microsoft and Windows CE are U.S. registered trademarks of Microsoft Corporation. ©1997 Hewlett-Packard Company PPG450

51 Seiko Epson Corp.



Seiko Epson Corp. is one of the three core companies of the 60-company Seiko Group, and like its corporate parent, subsidiary Epson America first achieved success by making a number of timekeeping devices. Today, piloted by CEO Norio Niwa, Epson America is a broadly focused company. In addition to its well-known ink jet printers, the company makes scanners, VGA projectors, and Zip drives. Likewise, Epson is leading the charge in affordable digital cameras. Seiko Epson president Hideaki Yasukawa led the parent company to \$5.67 billion in the fiscal year that ended March 31, 1996.

www.epson.com

52 Xerox Corp.



The company that invented the photocopier is now pushing to the next generation: digital copy machines that can be upgraded to serve as high-speed printers for computer networks. Xerox said digital copying products accounted for 34 percent of its revenues for the last quarter of 1996, as the company capped the year with revenues of \$17.38 billion. Printers for digital production work generated another \$1.8 billion in revenues. CEO Paul Allaire said the company plans to expand its outsourcing business, which generated \$1.3 billion in 1996 revenue, to include more products in the fields of consulting, software, and Internet business.

www.xerox.com

53 Iomega Corp.



With fortuitous timing, a masterful marketing campaign, and a solid product, Iomega almost single-handedly made mass storage chic. Since launching its 100MB Zip drive in 1995, it has sold more than 5 million units in just two years. Headquartered in Roy, Utah, Iomega brought in \$1.21 billion in 1996

revenues under CEO Kim B. Edwards. With the Zip a near standard in removable mass storage, Iomega branched into the high end with the 1GB Jaz drive, while seeking a new front in the tape-storage market with its Ditto product line.

www.iomega.com

54 Dialogic Corp.



With approximately 800 employees, Dialogic Corp. has been manufacturing computer components since 1983. The company has been the first to market with such products as multiline PC voice-processing cards and computer fax boards, among other items. In the past year, companies such as VocalTec have incorporated Dialogic boards in products that allow Web surfers to speak with agents in call centers directly through the Internet. Under the direction of CEO Howard Bubb, the company posted 1996 revenues of \$59.4 million.

www.dialogic.com

55 Samsung/AST Research



The 30 companies in the Korea-based Samsung Group manufacture everything from consumer electronics to hubs and network switches. Under CEO Kwang-Ho Kim, Samsung Electronics is the world leader in DRAM production and one of the largest semiconductor manufacturers in the world. Samsung Electronics recently agreed to acquire 3DO's hardware unit for \$20 million. The privately held Samsung Group had estimated 1996 revenues of \$87 billion.

www.sosimple.com

56 Logitech International SA



Logitech was founded in 1981 by two European computer engineering students who were studying at Stanford. Company president Pierluigi Zappacosta, together with CEO Daniel Borel, switched the firm's emphasis from soft-

ware to peripherals and made a name for Logitech through direct marketing. This led to deals with Apple, HP, and IBM. Now the world's top producer of computer mice and other input devices, the company posted revenues of \$413.7 million in 1997. With its American subsidiary, Logitech Inc., the company produces a wide range of Sensewear input devices. The products run the gamut from joysticks to scanners.

www.logitech.com

57 Matsushita Electric Industrial Co. Ltd.



Panasonic Communications & Systems Co.'s parent company, Matsushita, got its start in 1918 by selling batteries and electrical appliances. Best known in the U.S. for its home audio and electronics products marketed under the names JVC, Panasonic, Quasar, and Victor, the Japanese giant pulled in \$64.10 billion in worldwide 1996 sales for the fiscal year that ended March 31 under the leadership of CEO Yoichi Morishita. Panasonic's strength in the U.S. computer business is in peripherals, where it focuses on CD-ROM drives and jukeboxes, monitors, CD-R drives, scanners, and printers. Matsushita is one of the largest makers of CD-ROM drives and one of the pioneering companies behind the development of the DVD-ROM.

www.panasonic.com

58 National Semiconductor Corp.



The chip maker spun off its Fairchild Semiconductor unit in March, retaining a minority stake in the company and letting it focus on its very own semiconductor business. Also in March, National bought Mediamatics—the world's largest supplier of audio/video decoders for personal computers—as it seeks to build business-making computer chips for home entertainment appliances. This line includes digital video disk players. CEO Brian Halla led National Semiconductor to a total of \$2.62 billion in 1996 revenues.

www.national.com



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59 PC Connection Inc.

PC Connection has recently skyrocketed since the early days of personal computers. In 1982, Patricia Gallup and David Hall began PC Connection as a mail-order business, selling IBM PC applications and peripherals. Today, the company enjoys a reputation as the premier reseller of PC and Mac hardware and software. Much of its success lies in its innovative and pioneering customer service offerings such as toll-free technical support and instructional videotapes. PC Connection has recently expanded beyond the reseller market and into television production and broadcasting.

www.pcconnection.com

60 Sharp Corp.



Founded as a metalworks in 1912, Sharp derives its name from the Ever-Sharp, the first mechanical pencil and one of the company's early successes. Today, under the leadership of CEO Haruo Tsuji, Sharp is a leading manufacturer of office and home electronics products, pulling in \$15.40 billion in worldwide sales for the 1996 fiscal year that ended March 31. In addition to developing a line of wide-screen notebook PCs, Sharp is focusing on the PDA market with its Zaurus line, which is designed to do battle with a wave of hand-helds running Windows CE.

www.sharp.co.jp/index-e.html

61 Fujitsu Ltd.



Fujitsu was spun off from the Communications Division of Fuji Electric Company in 1935. Today, led by CEO Tadashi Sekizawa, Fujitsu is a diverse company, with revenues of \$35.49 billion for the fiscal year that ended March 31, 1996. In addition to its printers, scanners, and mass-storage products, Fujitsu America has recently introduced low-cost and ultraportable versions of its LifeBook notebook PCs. A leader in plasma display technology, Fujitsu recently made a splash with its introduction of the Plasmavision, a 42-inch plasma monitor developed in conjunction with

Pixelworks. Fujitsu is also a major force in mainframe computers.

www.fujitsu.com

62 Hitachi Ltd.



Founded in 1910, Hitachi is one of Japan's largest electronics and industrial equipment companies. The manufacturer of semiconductors and electronic components employs 330,000 people worldwide under president Tsutomu Kanai. Besides selling notebook computers through Hitachi America in the U.S., Hitachi develops notebook screen technologies, new forms of electronic money transfers, and its own SuperH family of RISC processors. Consolidated sales for the fiscal year that ended March 31, 1996, totaled \$75.77 billion.

www.hitachi.com

63 NEC Corp.



Founded in 1899, Nippon Electric Co., or NEC, grew to become a major telecommunications equipment manufacturer. In the 1960s and 1970s, it expanded into appliances and computers. By 1985, it had become the world's largest semiconductor manufacturer and the second-largest PC maker in Japan. Today, with \$41.38 billion in revenues for the fiscal year that ended March 31, 1996, NEC is focusing on Internet and intranet technology under chairman Tadahiro Sekimoto.

www.nec.com

64 Borland International Inc.

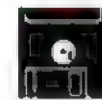


The maker of software for developers of desktop, network, and Internet applications is setting a new course after posting a loss of \$108 million in 1996. Founded in 1983, Borland had revenues of \$151.4 million in the fiscal year that ended March 31, 1997. CEO Delbert Yocam took over the company in December and began cutting costs in hopes of turning the company around by March 1998. He said Borland's greatest potential lies in network- and

Internet-related software. The company also licensed its development software to Oracle for use with Java and C++.

www.borland.com

65 MetaTools Inc.



Though it has existed in various forms since 1987, MetaTools has become a recognized name only with the success of its Kai's Power Tools and Bryce products. The company now focuses on providing sophisticated graphics tools, expanding the capability of desktop graphics programs through the Adobe plug-in specification. Under CEO John J. Wilczak, the company had estimated 1996 revenues of \$28 million.

www.metatools.com

66 Matrox Graphics Inc.



Since becoming independent of parent company Matrox Electronic Systems in 1994, Matrox Graphics has shipped more than 6 million graphics accelerator cards. The privately held, Canadian-based company has enjoyed impressive growth since its inception as an independent entity. The popularity of its Millennium and Mystique accelerator card lines has led to supply agreements with such companies as Compaq, Gateway 2000, and NEC. Under president Lorne Trottier, Matrox had estimated revenues of \$500 million for the fiscal year that ended March 31, 1997.

www.matrox.com/mga

67 Sybase Inc.



Sybase has made a meteoric rise in the database world since its 1984 inception, adopting an open client/server strategy and providing a generic interface between data sources and various clients. Sybase stumbled in 1995 when its SQL Server Version 10 shipped with many bugs. The company's loss of customers and market share ultimately led to a restructuring, with Mitchell E. Kertzman stepping up to bat as CEO last year. Since then, the com-



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pany has enjoyed a bit of a turnaround, with two consecutive profitable quarters and total 1996 revenues of \$1.01 billion. www.sybase.com

68 MCI Communications Corp.



The company that helped break up AT&T's telephone monopoly is now one of the world's top Internet service providers, boasting the fastest Internet network in the world (622 Mbps). MCI, which first offered Internet access in 1987, says 30 percent of Fortune 100 companies now use it for Internet services. With 1996 revenues of \$18.49 billion, the company expects its Internet business, currently generating revenues of \$100 million a year, to grow to \$2 billion annually by 2000. CEO Gerald Taylor is leading MCI's planned merger with British Telecom, and the new company, Concert Communications, will offer an international Internet site-hosting service later this year.

www.mci.com

69 Motorola Inc.



Motorola's first product, the revolutionary battery eliminator, allowed people to operate radios directly from household current. Today, Motorola is one of the world's leading providers of wireless communications and semiconductors, bringing in \$23.96 billion in 1996 revenues. In partnership with Apple and IBM, Motorola manufactures Apple clones using the PowerPC chip and leads the pack in some of the fastest-growing semiconductor markets. CEO Christopher Galvin hopes one of those markets may produce what proves to be the preferred payment method of the future: microcontroller-based smart cards.

www.mot.com

70 Hayes Microcomputer Products Inc.



The company that set the modem standard came out of bankruptcy in March and has halved the price of its top-selling

Optima modem. CEO Joe Formicelli, formerly VP of worldwide manufacturing at IBM, joined Hayes in May 1996 with plans to position the company as a developer of telecommunication standards and infrastructure. Privately held Hayes finished the fiscal year that ended September 30, 1996, with revenues of \$280 million and demonstrated at Comdex its smart-card modem—the latest in Internet commerce technology. It also plans to launch a brand-new series in the field of remote-access and routing products.

www.hayes.com

71 Adaptec Inc.



Adaptec has enjoyed quarter after quarter of profitability since going public in 1986, manufacturing components that link various kinds of PCs to the outside world of printers, RAID, CD-ROM drives, and other peripherals. Adaptec is a pioneer of adapters for the new IEEE-1394 specification, which allows up to 63 devices to connect with a single PC. Under CEO F. Grant Saviers, it posted revenues of \$934 million for the fiscal year that ended March 31, 1997. Currently, Adaptec is pushing for wider adoption of its SCSI hard disk adapters.

www.adaptec.com

72 Philips Electronics NV



Philips Electronics NV has played an especially critical role in the development of the CD-ROM market. Philips and Sony introduced the first CD-ROM and, since then, have had a leading role in authoring standards for the industry. In 1996, Philips introduced its recordable CD-ROM (CD-R). It also was first to market with a complete CD-R back-up kit designed for use with desktop computers. Philips has announced it would bundle VDOPhone software with its EasyCAM videoconferencing kit, bringing videoconferencing to the consumer market. The Netherlands-based giant posted total 1996 revenues of \$39.72 billion.

www.pps.philips.com

73 Western Digital Corp.



The third-largest maker of PC hard disks is growing fast as it tries to close in on industry leaders Seagate Technology and Quantum. Western Digital already has taken in more revenues in the first nine months of its current fiscal year (\$3.1 billion) than it did for the entire year that ended June 30, 1996 (\$2.87 billion). The gain came even as hard disk prices fell, and CEO Chuck Haggerty said he expects strong growth to continue in the next few quarters. Along with top customer IBM, Western Digital sells its hard disks to Compaq, Dell, Gateway, and Hewlett-Packard.

www.wdc.com

74 Activision Inc.



Activision has weathered the tempestuous electronic gaming industry since it all began, making cartridges for Atari in the early 1980s. After filing bankruptcy in 1991, Activision has bounced back, with \$86.5 million in revenues for the fiscal year that ended March 31, 1997. It has steadily regained leadership in the field under CEO Robert Kotick, who revived the company after five consecutive years of losses. Activision has soared to market dominance thanks in large part to the runaway success of MechWarrior 2, as well as the popularity of other gaming titles. These successful products include the well-known Spycraft and Zork: Nemesis.

www.activision.com

75 Cirrus Logic Inc.



Chip producer Cirrus had a somewhat rocky year, despite \$917.2 million in total revenues for the fiscal year that ended March 29, 1996. It still has a strong market base, however, not to mention healthy export sales. CEO Michael L. Hackworth heads the company, which is well respected for its chip research and related products. Cirrus is continuing joint research ventures with both IBM

and Lucent Technologies. In this capacity, it produces chips for various computer products. These range from graphics accelerator cards to hard disk controllers. www.cirrus.com

76 Cabletron Systems



Like many of the top networking companies, Cabletron Systems is preparing for the corporate intranet boom. CEO S. Robert Levine looks forward to providing customers with the increased bandwidth and management control necessary for a successful intranet. Cabletron acquired the Enterprise Networks Business unit of Standard Microsystems Corp. and, using its technology, launched a line of Fast Ethernet products for smaller companies. Cabletron posted revenues of \$1.41 billion for the fiscal year that ended February 28, 1997, and began the new year by acquiring The OASys Group. www.cabletron.com

77 ATI Technologies Inc.



ATI continues to stay on the cutting edge of graphics chip technology for both the Apple and PC operating systems. Under the direction of CEO K.Y. Ho, ATI continues to upgrade its RAGE-based graphics accelerators for such new technologies as the DVD. After slightly more than a decade in existence, ATI posted \$466.6 million in sales for the fiscal year that ended August 31, 1996. www.atitech.com

78 Aimtech Corp.



Aimtech, a developer of multimedia authoring systems, was established in 1984. The privately held company is known for such products as IconAuthor, a software package for developing interactive multimedia applications, and CBT Express, a computer-based training development system. 1996 saw Aimtech, headed by CEO Andrew J. Huffman, debut Jamba, a Java development envi-

ronment designed for ease of use and practical business application, and IconAuthor SE, a low-cost version of the product. 1996 revenues was estimated at \$10 million.

www.aimtech.com

79 Computer Discount Warehouse Computer Centers Inc.

CDW was born in local newspaper ads taken out by CEO Michael Krasny. From these humble beginnings, he has developed one of the most influential direct-marketing companies in the computer industry. CDW offers discount computer equipment through its catalogs, sales outlets, and expansive Web site. The company enjoyed 1996 revenues of \$927.9 million and loyalty that has translated into 80 percent of sales from repeat customers. www.cdw.com

80 Quarterdeck Corp.



Quarterdeck—a maker of diagnostic, performance, and Internet communications software—posted revenues of \$165 million for the fiscal year that ended September 30, 1996. Along with subsidiary StarNine Technologies, which develops Internet tools for the Macintosh, Quarterdeck produces such popular tools as CleanSweep, HiJack Pro, and WebCompass. CEO Curtis Hessler seeks to further Quarterdeck's success in the utility market by continuing to create products that enhance performance, simplify system management, and reduce the cost of PC ownership.

www.quarterdeck.com

81 CompuServe Inc.



CompuServe's flagship service, recently renamed CSI, is the second-largest U.S. online service. Led by acting CEO Frank Salizzoni, CompuServe posted \$793.2 million in revenues for the fiscal year that ended April 30, 1996—its first year as a public company. Faced with increasing competition from the Web and rival America Online, CompuServe last year launched SpryNet, its Internet-only service, followed by the ill-fated family service Wow!, which

shut down early this year. Through its Network Services division, CompuServe also provides Internet and intranet services to corporate customers. Recently, CompuServe has faced the possibility of being sold by corporate parent H&R Block.

world.compuserve.com

82 idealab!



idealab builds Internet start-up companies. Led by founder and chairman Bill Gross, the privately funded think tank now nurtures about 20 fledgling businesses in various stages of development. idealab functions as a family of companies that share a common pool of information and expertise, but each start-up is a separate entity controlled by its own management team. In exchange for its investment of creative support, seed capital, and assistance with administrative services, idealab takes an equity stake, though not a controlling interest, in each company. idealab's progeny include answers.com, CareerLink, and CitySearch.

www.idealab.com

83 DeLorme Mapping Co.



DeLorme is a classic example of a traditional company embracing the information age. Having published paper maps since the 1970s, this privately held company, with estimated revenues of \$30 million, entered the world of computer mapping. Its popular CD-ROM Street Atlas USA has been followed by several other CD map titles, as well as a new phone directory disk. CEO David Delorme is piloting the company into new aspects of the industry with efforts such as its first hardware product, the Tripmate GPS. DeLorme has also embraced the Web, with free mapping sites such as CyberAtlas and CyberRouter.

www.delorme.com

84 Informix Software Inc.



Informix has grown steadily in influence over the database market. Last year, In-

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formix introduced its Universal Server, an upgrade to the relational database Informix Online 7.2. The Universal Server is an object/relational database that accepts and indexes nontraditional data types. Informix Corp., of which Informix Software is an operating subsidiary, posted 1996 revenues of \$939.3 million under CEO Phillip White. www.informix.com

85 Lexmark International Group Inc.



Lexmark is the printer, developer, and supplier sprung from IBM's Information Products business in 1991. It was one of the first printer vendors to include a power-down option when a printer is not in use, and it is a pioneer in high-resolution 1,200-dpi laser printers. Under CEO Marvin L. Mann, the company posted 1996 revenues of \$2.38 billion. www.lexmark.com

86 Madge Networks Inc.



Madge Networks' end-to-end network solutions are built on the company's vision of integrated data, video, and voice. Betting that ATM technology is the future of networking, it plans to deliver the multiservice network. Led by CEO Robert Madge, the company posted \$482.1 million in 1996 revenues and this year released its router-replacing all-silicon multilayer IP/IPX LAN switch. Other technology plans from Madge include LAN-integrated videoconferencing and telephony software. www.madge.com

87 Broderbund Software Inc.



Helping it to reach sales of \$186.2 million for the fiscal year that ended August 31, 1996, CEO Joseph Durrett showed Broderbund how to market games without the violence that drives much of the competition's sales. To exploit the new playing field of the Internet, Broderbund recently entered into a partnership with NetPlay, which will allow players to com-

pete for prizes in the NetPlay Game Club. www.broderbund.com

88 Phoenix Technologies Ltd.



Phoenix Technologies founder Neil Colvin was one of the first engineers to decipher the basic input/output system code of the IBM PC, and his company quickly dominated the system BIOS market. In the early 1990s, however, a failed diversification effort led to a narrowly averted hostile takeover bid, extensive litigation, and major staff resignations, including Colvin himself. Since then, a corporate restructuring and a series of partnerships have returned the company to prosperity under CEO Jack Kay. Phoenix pulled in revenues of \$72.1 million in the fiscal year that ended September 30, 1996, and its BIOS is used by more than 13 million PCs worldwide. www.ptltd.com

89 Power Computing Corp.



Power Computing was the first and, so far, is the foremost Mac-clone vendor. CEO Stephen Kahng steered the privately held company into the pole position by developing a working model of a clone a year before Apple licensed its Mac OS. Power Computing is now the largest vendor of personalized Mac-compatible systems. With a combination of fast processors and competitive pricing, Power Computing clones brought the company an estimated \$500 million in 1996 revenues. www.powercc.com

90 Be Inc.



Eschewing the fight of "everyone versus Microsoft," Be is planning to take on the Mac. Be CEO Jean-Louis Gassée, former president of Apple Computer's product division, is developing the BeOS, an operating system designed to fit the needs of the new-media producer. To run the BeOS, Be is also developing the BeBox, a multi-processor machine that will have the price tag of a mainstream PC. With the BeOS

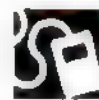
running on Power Macintoshes, Be is working to let it run Mac software as well. 1996 revenues were estimated at less than \$2 million. www.be.com

91 Number Nine Visual Technologies Inc.



Number Nine, a creator of high-performance visual technology solutions, was founded in 1982—first hitting the market with the Apple Booster, a CPU accelerator board for the Apple II. The company's video and graphics accelerators, display control software, and high-performance software drivers brought revenues of \$118.5 million in 1996. CEO Andrew Najda hopes to make the company the leading supplier of high-performance visual-accelerator solutions for the PC, Mac, and multimedia marketplace. www.nine.com

92 Eastman Kodak Co.



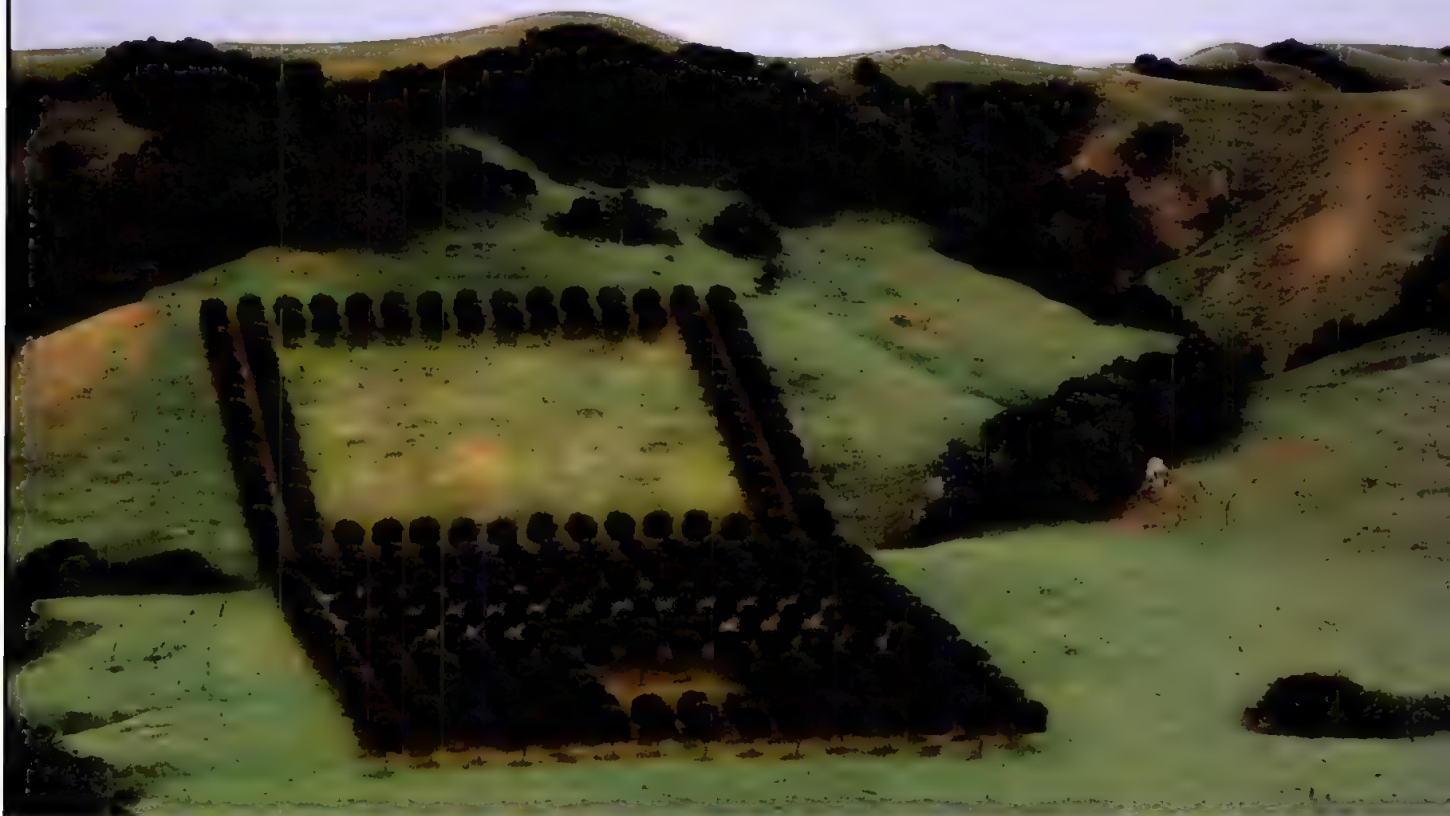
The company that invented modern photography more than a century ago is working hard to lead the next revolution: digital pictures. Kodak recently unveiled a point-and-shoot digital camera and also makes optical scanners and data storage devices. In March, Kodak bought Wang Laboratories' software unit for \$260 million, renaming it Eastman Software. The division will write software for office applications, including managing documents and workflow. Under CEO George M.C. Fisher, Kodak posted 1996 revenues of \$15.97 billion. www.kodak.com

93 The Santa Cruz Operation Inc.



SCO is the top provider of Unix server and host systems, holding more than a 40 percent market share. Best known for its servers, such as OpenServer and UnixWare, SCO was one of the first companies to introduce Unix systems for the Intel processor platform. CEO Alok Mohan led SCO into new territory last year, as the compa-

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ny developed software that integrates Windows clients with Unix servers, layered products to enhance Unix server performance, and embedded systems and Unix source technology. These additions showed their impact in fiscal 1996, which ended September 30, as SCO reported record revenues of \$207.9 million.

www.sco.com

94 ViewSonic Corp.



A leading supplier of high-performance computer color monitors and uninterruptible power supplies (UPSs), the privately held ViewSonic has built its reputation by offering state-of-the-art display technology at affordable prices. Formerly Keypoint Technology Corp., the company is run by CEO James Chu, with estimated 1996 revenues of \$550 million.

www.viewsonic.com

95 Rockwell Semiconductor Systems



Rockwell Semiconductor Systems, the computing subsidiary of Rockwell International Corp., is a leader in semiconductor technology. Led by president Dwight Decker, the division accounted for \$1.59 billion of Rockwell International's \$10.37 billion revenues for fiscal 1996, which ended September 30. Rockwell's main focus is communications, as it develops a wide array of wireless applications as well as fax and modem devices. In January, Rockwell shipped its first sample 56-Kbps modem chips known as the K56, and demand from modem manufacturers has grown significantly throughout the year. Rockwell also has a division that designs and manufactures integrated circuits for graphics, multimedia, imaging, and communications applications.

www.nb.rockwell.com

96 SAP AG



The German SAP, celebrating its twenty-fifth anniversary in 1997, controls almost one-third of the worldwide market for

corporate client/server application programs. Its flagship product, R/3, has been updated with Release 3.1 to offer year-2000 compliance. Dietmar Hopp, SAP's chairman of the executive board, is optimistic about the R/3 system enabling the company to expand on its 1996 revenues of \$2.40 billion.

www.sap.com

97 The Learning Company Inc.



With its acquisition of The Learning Company in 1996, Softkey International acquired a new name as well. Best known for its reference, lifestyle, and productivity software, such as WordStar and Compton's Interactive Encyclopedia, The Learning Company has recently expanded into the areas of educational software and multimedia with the acquisition of Aris Multimedia Entertainment, Educoft S.A., and Minnesota Educational Computing. By focusing on the lower end of the market and leaving other companies to produce higher-priced products, The Learning Company posted revenues of \$343.3 million in 1996 under the leadership of CEO Michael Perik.

www.learningco.com

98 Tektronix Inc.



With its Phaser family of color-ink printers leading the way, Tektronix continues to dominate the workgroup printing market. Its newest printer, the Phaser 600, adds wide-format printing to the list of Tektronix's innovations. It has also recently unveiled PhaserLink software—a management program for networked color printers. CEO Jerome J. Meyer led the company to revenues of \$1.77 billion for the fiscal year that

ended May 25, 1996. Since acquiring Lightworks, a video-editing product manufacturer, earlier in the year, Meyer plans to concentrate on the company's video networking products.

www.tektronix.com

99 Yahoo! Inc.



David Filo and Jerry Yang were Ph.D. candidates at Stanford University when they conceived the Internet search engine Yahoo! Three years later, Yahoo! is one of the most widely used navigational tools on the World Wide Web; there were 20 million page views a day last December. Yahoo! offers subcategories specific to several major American cities, and it has branched out with guides for France, Germany, and Japan under CEO Tim Koogle. The company raised \$35 million in an April 1996 initial public offering and posted 1996 revenues of \$19.1 million.

www.yahoo.com

100 Firefly Network Inc.



From the MIT Media Lab straight to the World Wide Web, Firefly is a pioneer in collaborative filtering, a technology that can predict a user's tastes by comparing them with a pool of previously gathered preferences. The privately held company has spent the past two years creating a virtual community of users who contribute to the database by rating movies and music. CEO Nick Grouf sees commercial potential for collaborative filtering anywhere personal preferences are found. In addition to its own Filmfinder and BigNote sites, Firefly will power collaborative filtering for Barnes & Noble when the bookseller hits the Web this year. □

www.firefly.com

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PC Tech

Dynamic HTML: More Client, Less Server

Microsoft and Netscape vie for the new standard for interactive Web pages.

By Neil Randall

Client-server computing has its distinct advantages, but the World Wide Web has uncovered some serious limitations as well. The most pronounced is in the Web's most basic design: All information is stored on servers, and users acquire any and all parts of it by specific requests through a series of HTTP transactions. In practice, that means the Web client (the browser) offers only static data, and any changes to that information must be effected by the server, where the information resides. That's fine, as long as changes to a Web page are minimal, since server access is then minimal as well.

But Web design has moved well beyond the static, minimalist model. Today's Web sites feature increasing degrees of interactivity, and constant change is de rigueur. The new designs place unprecedented demands upon the server, because every time something on a page changes, the browser has to connect to the server and ask for the new material. With popular sites, it's easy for the server (or, as is often the case, multiple servers) to get overloaded. But much more important, such designs force site visitors to wait. And that's something Web users are less and less inclined to do.

Enter dynamic HTML. Closely related to the Cascading Style Sheets (CSS1) initiative of the Internet Engineering Task Force, dynamic HTML exists to provide a means of updating Web pages without requiring the client to reconnect to the server. Dynamic HTML helps to transform the static nature of a retrieved HTML document by incorporating elements that, in effect, change the document on the fly. These elements affect the document on the client's side of the transaction—on the user's local machine. We're all well aware that computing on a local processor is

much faster than computing over a network, especially a wide area network, and that's the charm of dynamic HTML. The code comes from a remote site, but the action takes place locally.

Actually, dynamic HTML, in its proposed incarnation, embodies two concepts. First is the dynamic local updating of Web documents, as I've just noted. But just as important to designers is greater control over a document's appearance and over the interface users interact with. dynamic HTML offers designers a chance to compose richer layouts with significantly stronger interactive components than before.

That's something the Web sorely needs, as it moves closer to fully functioning multimedia.

Of course, this isn't the first time attempts have been made to implement changes on the client side of the Web equation. On a fairly minor level, client-side image maps moved the mapping coordinate scheme to the browser, considerably increasing usability as a

result. Java takes the idea much further, using the browser as an application launcher, with the application running entirely on the local machine. But for HTML, Web browsers have been nothing but display mechanisms, whose tagging system is focused on static page layout (albeit with many improvements in this area over the years). At the hands of some extremely creative and determined designers, HTML documents have managed to approach magazine pages in appearance. But it's clear that if the Web is to keep growing, it needs much more than improvements in page layout. It needs, in a word, *interactivity*.

Dynamic HTML changes the game. Page styles, including fonts and element positioning, can change on the fly, in order to get the designer's ideas across more actively or tailor a page precisely to a user. Graphic elements can move

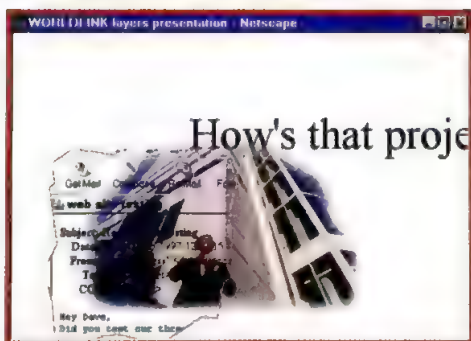
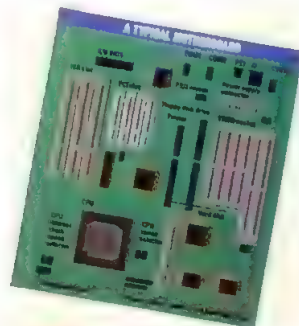


FIGURE 1: This Netscape Navigator 4.0 screen shows HTML elements on top of other HTML elements.

INSIDE



TUTOR: A step-by-step guide to upgrading the motherboard on your older PC. Page 261.

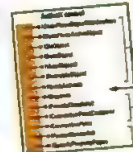


OPERATING SYSTEMS:

Linux: the free way to try out an alternative multitasking operating system that's chock-full of Internet power. Page 267.

POWER PROGRAMMING:

Version 2.0 of the Active Template Library lets you create slim, visual ActiveX controls. Page 273.



UTILITIES: OpenTrap lets you record file system activity in Windows 95 so you can diagnose problems with your system. Page 281.

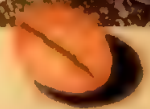
SOLUTIONS: Dealing with spaces in filenames, testing your joystick, preventing accidental record deletion in Microsoft Access, and more. Page 335.

PC Tech Online

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JavaTM Computing enriching the future of your business



So

WHAT'S
THE
ANSWER?JAVA
COMPUTING

It's time for a bit of invention in response to all of the necessities...



Necessity, we've always been told, is the mother of invention. Rarely have those words rung more true: these days, businesses of all kinds face a phalanx of new necessities:

- **Forging cooperative links.** Organizations need to work closely with more and more people outside their corporate perimeters, especially partners and suppliers. This is particularly true for businesses with a strategic mandate to focus on core competencies and outsource activities that don't help competitively differentiate the organization. Archaic, inefficient communication and information sharing among partners and with suppliers is simply unacceptable in this just-in-time era.

Necessity: solutions and tools that enable effective, realtime cooperation within and between enterprises. Early adopters gain competitive edge in customer satisfaction, cost containment and product quality.

- **Knowing thy customers.** Staying close to customers to understand their needs and recognize when those needs change stands paramount in any age. Current information technology offers important ways to improve customer service and boost product quality, and most of your customers know this. Hence you're confronted with both a promise and a threat: you can use today's technology to find out a great deal about what your customers want and need — or you can ignore the technology's potential and lose competitive

ground to others who embrace it.

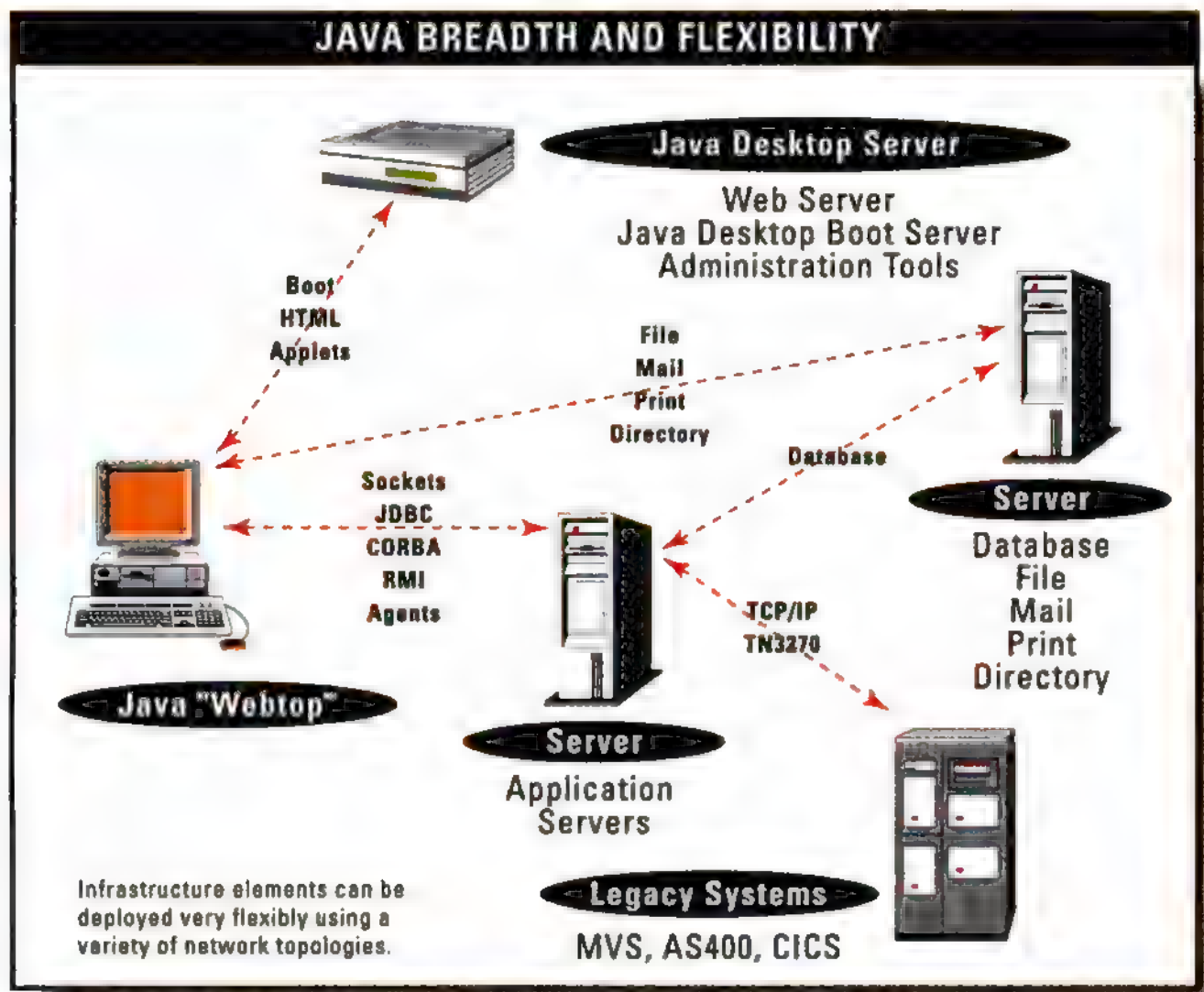
Necessity: solutions and tools that make it easy and simple to gather customer data and improve an organization's ability to respond quickly and accurately to customer demands and concerns. Early adopters benefit from better understanding of their markets, an ability to recognize trends faster and opportunity to plan appropriate strategies.

- **Working virtually.** Sometimes business can be conducted most successfully away from the office. Today's information technology enables many employees to work on the road, from home or from other virtual workplaces.

Necessity: solutions and tools that cost-efficiently support the wandering workforce with balanced, easy-to-access end-user computing capabilities. Early adopters field more productive, happier employees able to interact better with each other as well as customers, suppliers and partners.

- **Taking it to the web.** A new medium of trade and transaction has begun to emerge from the same Internet technologies that soldiers and scientists pioneered 20 years ago and that companies the world over now use to transport the many messages of everyday business. It is, after all, a short step from talking about a commercial transaction over the Internet to conducting and completing such transactions over the Internet.

Necessity: solutions and tools that enable businesses to offer convenient



and secure electronic commerce capabilities to customers. Early adopters will claim whole new kinds of market share and customer loyalty as they explore and exploit a brand new commercial landscape.

These new necessities have spawned much adaptation of existing systems, but as any manager can testify, unresolved problems and unconquered barriers loom large. Applications remain limited to particular computing platforms. Information sharing across business environments continues to be spotty and unreliable. The scope and potential of new technologies bulging with promise is hobbled because they cannot be retrofitted to work with older systems.

Clearly, it's time for a bit of invention in response to these necessities: Java™ computing. A whole new way to deal with information and information systems, Java computing overcomes the suffocating problems that keep traditional PC-oriented client/server computing costly, cumbersome and failure-prone.

Java computing puts object-oriented programming to breakthrough use: downloading nuggets of Java applica-

tion code from server to client on demand, regardless of the platform.

Since Java applications normally reside on a server and are delivered to a client via standard network protocol only when needed, both application code and client data storage can be centralized on servers, along with administration and configuration control, enabling organizations to increase the cost-efficiency of their information systems infrastructure.

Unlike any other kind of computing environment, Java computing offers an architecture that leverages enterprise computing investments across all platforms. If you want to revitalize, not replace your existing systems, you need Java technology. And if you want to exploit emerging opportunities in Internet-enabled commerce, Java computing is downright essential.

JAVA COMPUTING: PRESERVE THE LEGACY & FOCUS ON THE FUTURE

Though it's just less than two years old, Java computing and the language

Safe and secure with Java computing

It's precisely Java computing's unique ability to distribute executable code over the Internet that has raised concern about its effect on network security.

Happily, much of the security needed to protect organizations using Java applets and applications containing executable code has been built right into the Java platform.

Applet limits

At least theoretically, a Java applet can come from anywhere and be capable of attacking unprotected machines in ways that might not be stopped by traditional methods. That's why the Java platform protects its users by placing strict limits on applets to prevent malicious applets from stealing information, spreading viruses or acting as Trojan horses for viruses. They cannot read from or write to the local disk. Standalone windows created by other applets are clearly labeled as being owned by untrusted software.

Applets are also prohibited from making network connections to other computers on a corporate intranet, which prevents malicious applets from exploiting security flaws that might lurk beneath a corporate firewall or in the underlying operating system.

Sandboxes

The Java platform's security allows a user to import and run applets from the web or an intranet without undue risk to the user's machine. The Java applet's actions are restricted to its "sandbox," an area of the web browser dedicated to that applet. The applet may do anything it wants within its sandbox, but cannot read or alter any data outside of its sandbox, allowing users to run untrusted code without compromising their trusted computing environments. If a user does accidentally import a hostile applet, the local machine will not be damaged.



100% Pure Java certified: Corel Office for Java

The first suite of office productivity applications written entirely in the Java language, Corel Office for Java offers a platform-independent, document- and network-centric, modular and extensible

environment for document creation and workgroup collaboration.

Corel Office for Java delivers a complete client/server enterprise solution that not only includes popular productivity applications but also provides workgroup functionality and back-end enterprise support. Corel Office for Java is an enterprise solution that will have full support for JavaBeans™, JDBC™, LDAP, vCalendar, ICAP, POP3, and IMAP4 protocols.

The importance of portability

Chris Biber, Corel's Director of Strategic Alliances, points to the cross-platform capabilities of the Java platform as integral to the entire Corel undertaking. Corporations with mixed platform requirements are looking for a unifying suite of office productivity components, available on all platforms, with a strong server basis, Biber says. Java's strengths in this area are a big reason Corel opted to develop an office suite for the Java platform from the ground up.

What's more, Java's platform-independence and architecture-neutrality enable Corel to improve the efficiency of its Java software development by orders of magnitude.

"By going with Java, we've made software upgrades and maintenance of Corel Office for Java much easier than ever

before," Biber says. Maintaining a single version of source code saves both time and money, and reduces the likelihood of introducing errors into the process. It's also a plus for corporations, who can dramatically decrease the burden on their own MIS departments as a result.

Office on the intranet

Corel is eyeing the growing corporate intranet trend with interest. Corel Office for Java is, in Biber's opinion, an ideal candidate for intranet deployment. One reason for that is its compact size: the client beta version weighs in at only three megabytes.

Another reason is the ability to instantly distribute Corel Office for Java over any local or wide area network. The application can be transparently downloaded — on demand — to the user's system from the central server where it resides.

In a corporate setting, this can be particularly advantageous, since all Corel Office for Java users are synchronized on identical software versions. Because the client side of Corel Office for Java has won 100% Pure Java certification, all documents are readable and editable across all platforms. These features, together with strong support for Internet standards, are essential to make effective workgroup computing an achievable reality, according to Biber.

Corel is also busy applying the Java platform to the Internet publishing process. With a new web publishing engine called Barista now integrated into Corel's WordPerfect 7 and Ventura 7, users quickly can transform existing documents and images into web-ready Java files — without any programming required. Every WordPerfect 7 and Ventura 7 user is now automatically a web publisher, with complete control over the look and feel of their material.

"Java's unprecedented cross-platform support and distributed architecture make all of this possible," says Biber. "Basically, Java has changed the rules."

Find out more about Corel Office for Java at <http://officeforjava.corel.com/>.

on which it's based has attracted more interest than the C programming language managed during its entire first decade.

But why has Java computing enjoyed such an unprecedented embrace? To paraphrase another famous moment of insight: it's the Internet, st-p-d! And many of the capabilities that make Java computing so attractive for Internet applications are even more valuable to the enterprise:

- **Powerful and portable.** The Java language is modern and object-oriented and comes complete with single-state and multiple interfaces — an efficient and powerful combination that works

well with the CORBA and DCOM distributed programming models. Meanwhile, the Java environment's standard, platform-neutral binary format at both source and binary levels renders it innately portable. And because the Java platform includes a language as well as a set of standard class libraries, it's easy to build powerful, mission-critical applications that run on any Java virtual machine in any environment.

- **Efficient and reliable.** The same Java applications run on all platforms and networks — a seamless environment reaching from server to client to cell phone and beyond. Thanks to its virtual

machine orientation, the Java platform's tightly designed set of bytecodes are easy to transport across Internet or intranet environments. And the same Java programming platform can be used to build your client and your server software. It encourages production of reliable, simple code and its object and component orientation promotes re-use and library-building. Java platform design also enables highly efficient code interpretation and compilation.

- **Safe and secure.** Java computing bolsters good software engineering practices, such as clearly separating interfaces from implementation, and easing



exception handling. So despite its power, the Java language is actually a safer development environment than low-level languages like C or C++; its uniform reference semantics, automatic storage management and lack of programmable memory management tools such as pointers eliminate one of the largest causes of programming errors; its sophisticated lexical exception mechanism helps developers produce robust code; and all Java operations are type-safe. Java bytecodes are defined at a high enough level, even in binary form, so that developers can verify that a binary is consistent with a valid source program.

• **Obsolescence-proof and future-ready.** Since Java enabled browsers installed on any kind of desktop system can display any HTML page, they can run forms-based HTML applications. With Java enabled web servers acting as gateways to in-place systems, HTML can be used as a way to publish

information both within your organization as well as to suppliers and customers.

• **Simple and familiar.** Many believe that the Java language is, basically, C++ done right. The Java language is far less complex than C++, while retaining most of its power. Java developers particularly benefit from the language's automatic storage management, which frees them from dealing with the intricacies of pointer arithmetic. Since Java syntax and semantics borrow liberally from the widely used C programming environment, the Java language is already familiar to an enormous and quickly expanding population of developers, even though it's very new.

The implications, of course, are profound.

Aiming for a Java computing front end to rejuvenate its printing and publishing operations, RR Donnelly & Sons Co. has invested \$500,000 to \$1 million over the last year to create a web-enabled publishing system that allows customers to receive titles in the media of their choice. Eliminating the sending of disks to and from customers, the firm plans to use the Java computing front end to immediately download changes customers have made via the Internet.

At a time when most organizations struggle to keep their desktop computing environments from careening into a chaos of incompatible platforms and costly you-can't-get-there-from-here scenarios, Java computing offers welcome — and necessary — relief.

COMPARING JAVA TO OTHER PROGRAMMING LANGUAGES

	Java	SmallTalk	ICL	Pearl	Shell	C	C++
Simple	●	●	●	◐	◐	◐	◐
Object Oriented	●	●	◐	●	◐	◐	◐
Robnet	●	●	●	●	●	◐	◐
Server	●	◐	◐	●	◐	◐	◐
Interrupted	●	●	●	●	●	◐	◐
Dynamic	●	●	●	●	◐	◐	◐
Portable	●	◐	●	●	◐	◐	◐
Neutral	●	◐	◐	●	◐	◐	◐
Threads	●	◐	◐	●	◐	◐	◐
Garbage Collections	●	●	◐	◐	◐	◐	◐
Exceptions	●	●	◐	●	◐	◐	◐
Performance	High	Medium	Low	Medium	Low	High	High

JAVA COMPUTING: IT FITS WITH WHAT YOU ALREADY HAVE

Are you looking for ways to preserve and extend your organization's huge investment in existing IT systems and applications?

Existing systems and data interoperate easily with Java enabled computers, so you can build Java frontends onto your current systems and take advantage of the benefits of Java while protecting your investments in hardware, software and training.

What about gradually linking your organization's diverse networks and architectures, shifting system and net-

JDBC classes deliver access to relational data

A standard set of Sun Microsystems' specified Java computing classes providing vendor-independent access to relational data, the JDBC class structure is modeled after ODBC. JDBC classes provide standard features, including:

- Simultaneous connections to several databases,
- Access to database dictionaries,
- Simple queries,
- Transaction management,
- Calls to stored procedures,
- Manipulation of precompiled statements with bind variables,
- Streaming access to long-column data,
- Descriptions of cursors.

Sun Microsystems' reference implementation of the JDBC class structure relies on an ODBC bridge: JDBC class calls get converted to ODBC calls and these, in turn, call a vendor-specific API.

The JDBC vendor-independent library provides access only to standard SQL types and does not support vendor-specific types or user-defined object types and collections. But the JDBC library is extensible and is capable of supporting new data types and, not surprisingly, vendors such as Oracle are providing their customers with complete and efficient implementations of JDBC classes. Vendors will also deliver JDBC extensions to support their own SQL types, as well as extensions to improve data throughput.



work management from idiosyncratic desktop systems to a network you can centrally control?

Both long IT experience and recent research have shown that an ability to centrally manage networks, servers and client desktops can save a bundle on the bottom line. With Java computing, you can begin to slowly create the more centralized, network-focused information environment your organization needs.

You can add Java computing capabilities now to large numbers of your proprietary PC platforms and stand-alone applications, then gradually supplement them with low-cost, easy to-administer network computers or replace them at your business convenience. Meanwhile, for those specialized applications requiring local processing

power, you can keep your high-powered desktop systems and add Java browser capabilities without incurring any hardware replacement or retraining costs.

And when you're ready to take the next step toward web-based commerce, your foundation technology, based on Java computing, can be extended and expanded as more Java-based hardware and software products continue to emerge.

The result? A low-cost, low-administration networked computing

environment that couples the flexibility of client/server systems with the centralized maintenance and administration of mainframes. The days of local administration of configuration files will be over and you'll be able to eliminate versioning problems, too, since applications on network computers will be instantly and centrally updated. Client management costs will stay in line and it'll be easy to scale up any computing environment, because the Java platform allows a comparatively high ratio of network computers per server.

Finally, your organization can begin to cost-effectively free itself from a rigid application architecture that limits the ways in which computers can add value when executing transactions, servicing customers, analyzing data and so on. The payoff is an information technology infrastructure that's much easier — and less expensive — to manage, maintain and grow with your business.

Already, 62% of Fortune 1000 companies are using the Java platform for some development, according to Forrester Research and 42% expect Java computing to play a strategic role within the year. Many larger Fortune 1000 companies eventually intend to convert as much as 90% of all their existing desktops to Java devices. Meanwhile, growing numbers of independent software vendors are revamping their enterprise applications using Java technology, including such major players as Oracle, IBM, Lotus, Novell, Netscape, Corel, Symantec, Borland, and many, many others.

<http://java.sun.com>

100% Pure Java certified IBM Host On-Demand

IBM's Host On-Demand is a 100% Pure Java certified solution that provides access to central computer applications and databases from any Java enabled end-user platform — a fast and easy Java based solution for customers wanting to use the Internet or corporate intranets for occasional access to central computer applications and databases.

An Internet-to-SNA connectivity solution that incorporates industry-standard Telnet 3270 (TN3270) protocols, Host On-Demand requires no customer programming or additional hardware. Users can initiate Host On-Demand from any Java enabled end-user platform by simply clicking on an SNA application hotlink within their web browser.

All the software needed is automatically downloaded in the form of a Java applet which disappears once the host session is over. Each time the user initiates Host On-Demand, the most up-to-date applet is downloaded.

"The explosive growth of the Internet has proliferated the use of the web browser as a familiar interface," says James Neiser, vice president of marketing at IBM Networking Software. "With Host On-Demand, customers can use their browser to explore new ways to take advantage of corporate information."

Giving users the power to browse corporate data

For example, Host On-Demand enhances an automobile manufacturer's customer service by making its inventory information available to dealerships via web browsers — 24 hours a day, seven days a week.

With Host On-Demand, regional insurance agents can now use web browsers to access corporate policy records and rate schedules — without having to install additional software. The insurance company also benefits, using Host On-Demand to streamline support by maintaining software on a small number of servers, instead of a vast number of individual workstations.

"Host On-Demand has been designed to connect through the Internet or intranets to leverage customers' existing investments in clients, servers,

distributed computing power and 3270 applications," explains Neiser.

"From a user perspective, availability of additional content and services is dramatically increased. Host On-Demand extends the availability of existing host data to a greater number of users without the need for costly, time-consuming installation of additional software or workstation programming changes."

What's IBM doing with Java computing, anyway?

Host On-Demand reflects both IBM's pledge to add significant Internet support to its multi-platform, multi-protocol communications clients and servers as well as its commitment to 100% Pure Java Initiative.

IBM has supported Java computing since its introduction. Why? Because Java computing's open-standard foundation gives businesses cross-platform support throughout and beyond the enterprise as well as a more cost-effective way to manage information. Providing customers with a complete solution for business is what makes the Java platform such a compelling new technology for IBM.

"Between IBM and Lotus, we have more than 1,000 developers in 24 labs in 21 countries, doing research and development in Java," said David Gee, worldwide program director, Java marketing at IBM. "We will spend hundreds of millions of dollars over the next few years on Java development. IBM is doing everything we can to deliver on the promise of Java, including working closely with Sun, Netscape and others on the 100% Pure Java Initiative."

For more on Host On-Demand access http://www.networking.ibm.com/hex/hexprod_en.html.

WEB COMPUTING WITH A MORE EFFICIENT INFRASTRUCTURE

What, then, should a Java computing infrastructure look like? As you begin developing and deploying Java computing capability throughout your organization, here are the elements you'll need and what you'll get from them:

An enterprise network based on an intranet to improve integration of corporate applications. Java computing relies on Internet standards and protocols, so you'll need an intranet — the application of Internet technologies and protocols in internal corporate information networks — founded on a TCP/IP-based network with both local (10-Base-T minimum speed) and wide area network connectivity where needed.

A web server that'll deliver HTML pages and Java applications and applets to desktop clients via your intranet. As your Java environment grows, you may need to replicate your web server so you can support more clients without increasing your administrative burdens.

Distributed application servers containing business applications or objects to be accessed by clients across the intranet. These servers interface with your existing code and databases to deliver application services to Java enabled clients.

Dedicated-function servers accessible by Java client applets (including database, file, print, mail, directory servers). Depending on the size of your installation and the needs of your organization, these services may also reside on the same physical machine on which resides your web or applet server.





Since the Java platform is based on an open architecture, anyone can use it. Today, the Java envi-

There are any number of ways this can happen. Take Microsoft's ActiveX as an example. Whereas the Java platform makes links to components in other computing models, ActiveX encapsulates components, which thereafter can run only on proprietary ActiveX platforms. When Java code is encapsulated into ActiveX, its cross-platform attributes have been compromised.

The 100% Pure Java logo: Cross-platform compatibility of Java applications

ronment is available on all major computing platforms and has been licensed for still others.

Many believe that genuinely platform-independent network computing depends on establishing and enforcing open, non-proprietary standards for the Java platform. Both end users and developers need assurance that programs written in the Java language will indeed run flawlessly on any Java certified platform or device.

But Java's platform-independence can be sustained only if everyone uses the same Java. Pure Java. In fact, we need a standard for 100% Pure Java.

Why? Because contaminated Java technology loses its platform-independence and its abilities to ensure a secure computing environment. Which means that contaminated Java technology simply isn't Java technology at all. But some might still claim it's Java, even though it's a proprietary knock-off that can't do the job.

The 100% Pure Java Initiative, supported by more than 100 independent computing vendors, defines an objective, consistent quality standard for Java software and published API specifications. Keep your future safe. Use only 100% Pure Java technology

Look for the 100% Pure Java logo on the products you buy to make sure that your organization's Java compatibility won't be contaminated or compromised.

An integrated management system for handling servers, networks and clients. This system will manage all elements in your network environment, including traditional PCs and less resource-intensive network computers.

These elements can be deployed very flexibly using a variety of network topologies. For instance, your branch offices or a customer site may have a local web server to boot and serve Java applets via a LAN to the local Java devices. Such a branch server would actually act as a mirror site of the master web server at your main office, so all of its administration could be accomplished centrally by means of Java front-end management tools.

Of course, anytime you're building custom software, you need to make sure that you're using not only the best development tools for the job at hand, but also the best

tools for integrating your new application into your existing IT architecture. So how does the Java platform stack up?

For a start, it's especially good for building next-generation software. Since Java technology has become so widely adopted by software tools vendors, many of the best traditional development environments and middleware tools are already available for constructing Java applications. There are also new Java based development tools from new vendors.



database API (see **sidebar**, pg. S6)) as well as to CORBA-based object servers (through a Java IDL API) and to other object servers (through a JavaBeans API, which integrates Java, ActiveX, OpenDoc and Live Connect objects into a new cross-platform framework).

In addition, many of Sun's Java allies have developed other useful connectivity tools, such as IBM's Host On-Demand (see **sidebar**, pg. S7) and OpenConnect's OC/WebConnect 3270 emulator written in the Java language.

Selecting the best Java development tool

Already, the variety of available Java development tools is so broad that you'll have no trouble finding the right toolset for your needs. To select the best Java development tool for you, focus on three criteria: developer experience, application type and developer platform.

For example, professional developers with C/C++ experience who need to

JAVA DEVELOPMENT: NEXT-GENERATION SOFTWARE

To be most effective, a Java computing infrastructure will probably require more than hardware, networks and off-the-shelf software.

Preserving your existing systems with Java computing

The Java platform is particularly effective when your organization needs to access existing databases and transaction systems as well as new applications. Why? Because the Java platform has been extended to connect to databases (through the JDBC Java

<http://java.sun.com>

build a complex, high-performance online transaction processing application should consider integrated Java development environments such as Sun's Java™ WorkShop™, Symantec Cafe and Borland Latte.

Why 100% Pure Java computing?

When you're developing Java applications, safeguarding their cross-platform portability is crucial if you want to integrate diverse corporate IT resources and ensure your ability to deliver the right information to the right people at the right time, regardless of data origin or its format and regardless of where your users are.

Java platform-independence works as long as everyone continues using the same Java computing standard and resists the urge to add non-uniform features that destroy its portability.

This is always a risk. In Microsoft's ActiveX component software strategy, for instance, Java applets are swallowed whole (encapsulation) and are no longer able to run on anything but Microsoft's proprietary Win32 platform.

In fact the risk of contaminated Java applications is strong enough that more than 100 vendors, led by Sun Microsystems, have launched the 100% Pure Java Initiative that defines an objective, consistent portability standard for Java software and published specifications. Only products that have achieved 100% Pure Java certification can exhibit the "100% Pure Java" logo.

This distinguished brand provides customers with a benchmark for portability that is unprecedented in the industry. The logo's presence on soft-

ware and hardware products guarantees its compatibility with all other 100% Pure Java products. So Java buyers get better products and more effective network computing environments.

Already several products have won the right to carry the 100% Pure Java logo, including:

- IBM's Host On-Demand.
- Corel's Office for Java.
- Oracle's Developer/2000 Web Cartridge.

INCREMENTAL DEPLOYMENT BEGINS WITH A JAVA BROWSER

A Java computing evolution can be undertaken gradually and seamlessly. In most organizations, it begins with putting a Java enabled web browser on every client desktop.

This platform — a Java browser atop any desktop client, including resource-rich, file-laden PCs — can be used to share information within an organization, initially in the form of Internet-standard HTML pages.

Do e-mail first. Since all client desktops have been made ready for Java computing, their Java enabled browser can also be used to roll out corporate applications. Make your first webtop application electronic mail — shifting to Internet standards for mail (IMAP4 and SMTP) simplifies management and familiarizes end-users with

browser capabilities and techniques.

Power to the network: support scalable multiprocessing. Java computing reliability and scalability depend on the network and servers. These need to support scalable multiprocessing, clustering and RAS features to ensure high availability and performance.

Integrate existing systems via your intranet. Access to these systems is provided through application server "glue code," or, in the case of

Together, GroupWorks Technology & ElderCare Information Network Inc. — unlikely allies — are building a Java based healthcare directory for nursing home providers and suppliers seeking potential customers nationwide. Now GroupWorks, which had no healthcare experience, has brought a stake in ElderCare, which had a good idea but no technical expertise, and will get a cut of the revenues once the new system is launched.

Oracle's Developer/2000 Web Cartridge is a 100% Pure Java certified environment that will enable organizations to rapidly deploy cost-effective intranet and Internet-based applications.

100% Pure Java certified Oracle's Developer/2000 Web Cartridge

Developer/2000 Web Cartridge delivers timely application development support for Java enabled applications and Oracle's recently announced Network Computing Architecture — a common set of technologies that allow all PCs, network computers and other clients to work with all web servers, database servers and application servers over any network.

"Oracle is 100% committed to 100% Pure Java — it's the wave of the future and will play a huge role across all tiers of Oracle's Network Computing Architecture," proclaims Sindy Braun, an Oracle senior marketing manager. "Java allows people to develop in a single language and deliver on multiple platforms; it's what's enabling us to get our applications running on something as cost-effective as the network computer."

The certification of Developer/2000 Web Cartridge makes Oracle the first major enterprise development tool vendor to offer a development tool under Sun Microsystems' 100% Pure Java Branding Program, which guarantees that applications don't contain any platform-specific code.

"100% Pure Java is one of the only ways to be certain we run on multiple platforms; that's what's really important here," says Braun. "Most organizations today have a variety of platforms; 100% Pure Java transcends the problem, which makes it especially attractive." And she warns, "Developers who don't use 100% Pure Java are limiting the deployment of their applications."

Developer/2000 Web Cartridge: Application development support

All applications built with current and prior versions of Oracle's Developer/2000 environment may be deployed on the web using Java Technology. The 100% Pure Java certified Developer/2000 Web Cartridge performs the bulk of the pro-

cessing on an application server. A Java applet is used for visual representation of the Developer/2000 applications and is downloaded when a user invokes the application.

The implementation of Java computing in the Developer/2000 Web Cartridge allows organizations to gain all the benefits of deploying Java applications without requiring developers to learn how to write Java code.

A long standing commitment to portability

Oracle's long standing commitment to portability and application partitioning has made Developer/2000 for the Web possible. The Developer/2000 Java applet makes portability across all client platforms transparent, from Windows to Mac to Motif to network computers.

"One of the chief reasons for Oracle's success is portability and the ability to run on many different platforms; it's something that's been needed in the industry for a long time," Braun believes. "Java brings that capability to everyone. Java's architected to be cross-platform and portable."

The Developer/2000 Web Cartridge will run on Windows NT and all major UNIX® server platforms. Developer/2000 is the first open database-development web tool created and available on NT, giving all NT customers thin-client access to workgroup and enterprise-level data.

"Many of the same benefits being touted for the web — including reducing maintenance and support costs of PCs — are available using 100% Pure Java," Braun asserts. "Statistics indicate companies spend more than \$10,000 per workstation per year on support and maintenance, but most users don't need industrial-strength PCs."

To get more information about Oracle, call 415-506-7000 or surf to <http://www.us.oracle.com/>.

current applications that do not have Java computing front-ends yet, through Java terminal emulator applets.

Target simple, repetitive apps. Initial deployment of Java devices should target applications that are less complex, narrowly focused and do not require access to productivity applications — examples include order entry, call centers, branch banking, reservations. Client desktops where such applications are conducted are better suited to so-called "thin" network computers that maintain little or no storage and memory resources, instead dynamically downloading both applications and files from central servers only as the job demands.

Save your PCs. As more general productivity applications become available in Java environments, wider deployment can begin. That doesn't mean trading in all existing desktop machinery and starting afresh. On the contrary, PCs can be kept running indefinitely by transforming them into network computers running Java enabled browsers.

Corel's Office for Java, certified as a 100% Pure Java application (see sidebar, pg. S4), signals full productivity desktop functionality in the Java environment and promises new life for your PCs.

Lotus Development Corp. has also launched a major Java initiative, code-named **Kona**, which includes Lotus' InfoBus technology enabling a new class of dynamic business applications for the web and personal computers. Kona applets are easier to create and much more powerful and interactive because they can share and exchange information with no programming required. Other aspects of Kona: a set of business productivity applets, an

-----> <http://java.sun.com>

operating environment and Java development work supporting open-standards protocols.

Unlike competitive offerings, Lotus' Kona applets are built from the ground up in the Java language to be compact, task-focused, modular, extensible, programmable and designed with an easy-to-use web-like interface.

Keep resources where they belong. Many of today's client desktops are more resource-intensive than they need to be. Up to 90% of some organizations' desktop clients don't require PC-level storage or memory; a "thin" client, with little memory, and maybe no hard drive at all, will do nicely as long as all the applications and data needed at that desktop can be dynamically downloaded on demand.

Such thin Java devices with access to server applets across your corporate intranet (and the Internet to the extent allowed by your network security policies) can cache Java applications and applets dynamically as needed, storing nothing locally. Disk caches to improve response time can be added to those clients needing to access large numbers of applications quickly, but these local disks would store no permanent data and require no administration.

Storage- and memory-intensive clients (such as PCs, Macs) would then be used only in certain realms, where key applications are diverse and require large amounts of local data manipulation and storage.

With Java computing, local client processing is used to reduce peak network and server loads, while all administrative and management tasks are handled centrally on the server.

PACKAGED SOLUTIONS FOR JAVA

Hundreds of software development companies have already produced package Java-based applications and applets for a growing range of tasks. Here are a few:

Business Applications

Computron
Dun & Bradstreet
Oracle
PeopleSoft
SAS

Manufacturing

Adra
BAAN
Computervision
Mentor
Metaphase
SAP
Sherpa

Finance

Airteam
GSI
Hani
Reuters
StockSmart
Tibco
Trimark

Education and Government

Facet Decision
Silver Platter

Desktop Applications

Active Software
Applix
Corel
Interleaf
Kinesis
Lotus
Sybase/PowerSoft

Development, Management and Middleware Tools

Atria/Pure
OpenConnect
Rogue Wave
Unify
Visigenic
Web link

Customer Management Systems

Broadway & Seymour
Cambridge Technology Partners
Graham Technology
Pega System
Scopus
Trilogy

Telecommunications

Solcast Technology
Ubiquity Software

CENTRALIZED MANAGEMENT FROM ANY CLIENT PLATFORM

Because all management in Java computing is accomplished at the server rather than at each individual desktop, you can greatly reduce the manpower you'll need to manage your desktop clients. There's no permanent client data or code, so there's no client state to

manage. A client hardware failure gets corrected by a simple swap of desktop machines. And you can centrally set policies that specify who can run which applications and access which resources.

Powerful tools like Sun Microsystems' Solstice™ Enterprise Manager™ system can manage all servers and clients in your IT environment. Internet standards like DHCP (Dynamic Host Configuration Protocol) allow automatic IP address assignment to clients, further

<http://java.sun.com>



minimizing desktop administrative tasks. Additional tools, such as Sun's Solstice™ Backup™ Archive and Solstice™ DiskSuite™, address the data backup, reliability and performance needs of your enterprise network.

With Java servers and Java powered network management tools, your network administrators can manage all systems from a central location, carrying out such tasks as the addition or removal of users, software configuration control, monitoring and troubleshooting. What's more, you can use a Java interface to, with proper authorization, access your centralized management environment from any Java enabled client platform.

Employee mobility. Java computing can make it easier to keep employees connected to the enterprise, too, even when offices get shuffled. For those with Java enabled network computers, there's no need to move desktop computer files when a person is moved, since no permanent client data or code resides on any desktop machine.

Instead, all permanent state information stays in the intranet web, so users may log on anywhere they can access the intranet and enjoy full access to their complete home environment. This kind of network-centric Java computing also makes it possible to provide mobile

users with their complete computing environment through authorized dial-up access at home or on the road.

IT'S EASY TO MOVE INTO THE FUTURE WITH JAVA COMPUTING

A full migration to Java computing will take several years but you can accomplish it easily in small steps without discarding a single existing computing application or platform.

New life for old Windows. Java clients can display any HTML page, so forms-based HTML applications also can be run from any Java browser desktop, including Windows 3.1 or Win95. Terminal applications (e.g., 3270 or VT100, etc.) also can be run anywhere a Java Virtual Machine is present via Java emulator applets.

Evolving from mainframe to server. Meanwhile, when business and technology considerations properly converge, your back-end systems can be gradually moved off mainframes to high-end servers.

The connectivity you need. Since Java Virtual Machines and just-in-time compilers are now included in almost

every major operating system, middleware can be written in any language, using off-the-shelf tools from a variety of vendors producing TP monitors, CORBA ORBs messaging and queuing systems. Middleware can also be written in the Java language to take advantage of Java's Write Once, Run Anywhere capability.

More than any kind of computing that precedes it, Java computing builds on your current infrastructure, positioning your company to fully exploit emerging technologies even as it extends the life of old systems beyond their creators' wildest imaginings.

Furthermore, moving to Java computing really is easy: you can implement incrementally, at a pace that fits your organization's needs and goals. You can keep your existing hardware or software resources, so it won't make your employees' training and skill sets obsolete.

Now is the time to carefully consider the possibilities and opportunities that Java computing opens up for your organization. You'll be in good company.

For more information about Sun Microsystems, Inc., JavaSoft or the 100% Pure Java Initiative, please visit our website at <http://java.sun.com> or call 1-800-JAVASOFT.



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FIGURE 2: In this Internet Explorer 4.0 screen, HTML elements are dropped into the picture by clicking the buttons on the interface bar.

across the page and animate, morph, or perform other special effects, all at the speed of the client computer, not the server connection. Perhaps most importantly for business, database searches and sorts can be performed more quickly than ever before over the Internet, making data presentation much more effective. And most of this happens without lengthy downloads and without consuming a user's disk space, the central problems of browser-based Java and ActiveX applications. You can't do as much with dynamic HTML as you can with Java or ActiveX, but you can do enough to bring Web-page interfaces out of the dark ages.

WHERE WE'LL SEE DYNAMIC HTML

Like other HTML developments, such as tables, frames, and even the good old BLINK tag, dynamic HTML will begin to appear on the sites of anyone concerned with keeping up with the Web-building Joneses. But the most potent uses of these new HTML elements will be found on business and entertainment sites first, education sites later. Business sites want to give their users a more attractive layout and a more functional interface, in addition to faster access to database information. Entertainment sites, meanwhile, will find that dynamic HTML offers a means of designing sites that appeal to their users directly and eliminate lengthy download times for multimedia experiences (entertainment people want the Web to work more like television in this regard). Education sites will find dynamic HTML useful for everything from online registration through online course offerings, in both of which a strong interface and fast data access are crucial.

A BATTLE IN THE MICROSOFT-NETSCAPE WAR

The next releases of the two major Web browsers promise to take full advantage of the first implementation of dynamic HTML. As of this writing, Netscape Navigator 4.0 beta 2 contains support for the proprietary LAYER tag, a major feature of element positioning, while

Microsoft has specified support for the newly adopted CSS1 standard in version 4.0 of Internet Explorer. For a while, the majority of dynamic HTML use will be in showcase sites, as Web designers learn to harness new features while waiting for the user base to adopt the upgraded browsers. By the time Internet Explorer 4 and Navigator 4 become the standards, dynamic HTML will be ready to make its move.

There's a problem, though. Netscape and Microsoft have very different ideas on what dynamic HTML actually means. Both agree on the fundamentals of active content and client-side interfaces, but beyond that they differ considerably. For its part, Microsoft is claiming adherence to W3C (World Wide Web Consortium) standards, while Netscape—as it has done in the past—offers to support the standard but to provide designers with extensions of its own.

The core of dynamic HTML lies in the CSS1 initiative. Cascading Style Sheets offer Web designers the long-desired ability to control the appearance (everything from fonts to white space) of not only a single page, but also an entire site, thereby ensuring a consistent and attractive appearance throughout. Where the dynamic portion comes in is with the W3C working draft of January 31, 1997, called "Positioning HTML Elements with Cascading Style Sheets" (www.w3.org/pub/WWW/TR/WD-positioning). There we find sections about *positioning* and *z-order*, both central to the layout control offered by dynamic HTML.

Positioning refers to the means by which designers can place specific HTML elements in specific locations on the page. Desktop publishers have been doing it very easily for years, but HTML designers have had to invent elaborate workarounds toward the same ends. Elements can be given an *absolute position* using *x*- and *y*-coordinates or a *relative position* using *x*-, *y*-, and *z*-coordinates.

Absolute positioning establishes a rectangular area in the document into which the HTML element will flow. The rectangle's position within the document will remain in the same place at all times; the browser will no longer determine where it goes. Relative positioning also creates a rectangle for an element, but designers can establish exactly where the element will first appear on the page and how that position will change according to a simple script. A designer can force an element to "move" across a page, for instance, by adjusting the element's relative position with a script in an external scripting language, such as JavaScript or VBScript. The two positioning types can also work together. A designer can place an element with an absolute position inside an element with a relative position, so that

the absolutely placed element retains its precise location within the relatively placed rectangle as the latter moves to a new position.

Z-ordering is also of great interest to Web designers. "Z" refers to the *z*-axis, which gives the illusion of depth to a display. Designers can establish different *z*-planes for different HTML elements, and depending on the *x*- and *y*-coordinates, these elements can overlap. The *z-ordering* feature lets designers determine the order of the elements, specifying which one will be on top, which will be on the second layer, which on the bottom, and so forth. The order can be easily changed using CSS tags, another means of simulating movement on the page.

The central differences between Netscape's and Microsoft's implementations of dynamic HTML lie in the positioning systems. Netscape has proposed a tag named LAYER, which provides three-dimensional positioning, while Microsoft has chosen the nonproprietary position controls proposed by the W3C. Netscape is also adopting JavaScript-based style sheets, while Microsoft is using ActiveX controls that can be scripted. The idea in both cases is to provide dynamic positioning for HTML elements, but since Microsoft has no current plans to support the LAYER tag in Internet Explorer and Netscape is uncertain about its degree of support for the W3C positioning proposal, Web designers are once again caught in a compatibility issue. If they use LAYER, they're locking out Internet Explorer users, and if they use ActiveX, they're locking out Navigator users. At this writing, the best bet for full compatibility is the Microsoft version without the ActiveX components (using the positioning and scripting available through the CSS1 standard), but that may well change over the next few months. If all of this frustrates you, you're far from alone.

Still, there's more to dynamic HTML than element positioning. Styles can be programmed to change on the fly, in order to give a Web page the kinds of interface we're becoming accustomed to in our desktop applications. One example is the hiding of elements. Using the `show` and `hide` attributes of CSS1, designers can specify when an HTML element will be displayed on the page and when it will be rendered transparently and therefore hidden. These attributes can be incorporated into form results to alter the visible elements on a screen, depending on a user's actions, or they can be tied to mouse pointer movement to create dynamic interfaces.

In the latter case, for example, moving the pointer over a specific element (an icon or button, for instance) could cause the element to change color, make a shadowing element visible, or cause a pop-up text box to appear.

PCTech

Internet Explorer 3.0 and Navigator 4.0 have implemented this kind of button treatment in their toolbars, providing visual interface cues for the user, so it only makes sense that similar visual cues should be present on the Web page itself. Furthermore, dynamic HTML makes use of visual effects similar to those found in slide presentation software (PowerPoint and company), to allow for various forms of transition between page elements or between entire pages, and for animation without the need for animated GIFs.

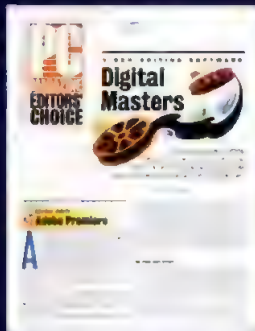
The data capabilities of dynamic HTML are crucial. Tables can be changed without a trip back to the server, and as a result designers are rethinking the ways data can be presented on a page. HTML tables can be bound to data sources, with requests to the data source generating new or updated tables on the fly, without the need for the designer to predetermine the precise layout of the rows and columns. This activity can occur on the browser side of the equation only, or with larger data sets as a combination of client and server interactivity. Data sourcing is handled through ActiveX in Internet Explorer and through JavaScript in Navigator (yet another potential designer nightmare), but the idea is the same. With no need to return to the server for regeneration, tables become much more capable as sophisticated information display mechanisms.

How dynamic HTML shakes out over the next months depends a great deal on whether Web designers are willing to work with two competing systems. Netscape still maintains a comfortable lead in browser share, and Version 4.0, with its advanced communications modules, gives no reason to suspect that this lead will diminish significantly. As a result, the LAYER tag will find quick and ready acceptance, as will JavaScript-based style sheets. But Microsoft is closer to standards adherence on this one (although the ActiveX issue continues to rear its ugly, incompatible head), and Internet Explorer's share of the browser market can hardly be ignored.

The good news is that whoever wins this one, or whatever compromises are made at the W3C level, by the end of 1997 designers and surfers alike will have a more active, more appealing, and more useful Web. Dynamic HTML will finally bring Web development into the same sphere of sophistication found on CD-ROMs or in desktop applications, and that's a very welcome thing. □

Neil Randall is the author of The Soul of the Internet (ITCP) and Special Edition Using Microsoft FrontPage (Que) and is a frequent contributor to PC Magazine.

A GREAT REVIEW IS A GREAT REVIEW IS WORTH REPEATING WORTH REPEATING



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Motherboard Replacement Surgery

This step-by-step guide makes your upgrade less painful and less risky.

By Neil Randall

Okay, here's the deal. You've got a perfectly good 486 or low-end Pentium system: lots of hard disk space, plenty of RAM in 72-pin SIMMs, good video and sound boards, and a fast CD-ROM drive.

Your keyboard is perfect, your mouse doesn't jerk, and your monitor is big, crisp, and clear. It would all be perfect if you weren't stuck with the old processor, especially since you're salivating over Intel's new MMX chip. The trusty old machine is no longer good enough and you've decided to take action.

What should you do? Well, you could buy a new machine, but since everything else is okay, why spend the extra money? You could buy just the MMX chip, but unless you bought your computer in the past couple of months, it probably won't support MMX anyway. The only feasible option is to replace your motherboard, but the whole idea seems as complex as an organ transplant.

The truth is, it's not exactly a walk in the park, but it's also not as hard as, say, getting Windows NT 3.51 to recognize your network card. All it takes is a little planning, a lot of patience, and understanding a few facts. The first thing you have to remember is that no matter how careful you are, it never works the first time. The second is: If you have to force something into place, you're doing it wrong. Last, just remember that the whole procedure will probably take more time than you imagine. Count on spending at least an entire day, preferably a weekend. Rush it and you're almost guaranteed to be sorry.

In this column, I'll outline the steps you need to follow when preparing for an upgrade. You'll also find a photographic walk-through, showing the procedure in its various stages of completion, on *PC Magazine's* Web site at www.pcmag.com. Of course, the standard disclaimers are fully in place: The pro-

cedure won't work in every situation, and once you start, the responsibility is all yours. Still, if your equipment is standard (as most computers are), you shouldn't have a lot of trouble. And the rewards—a faster machine with BIOS support for all the newest up-

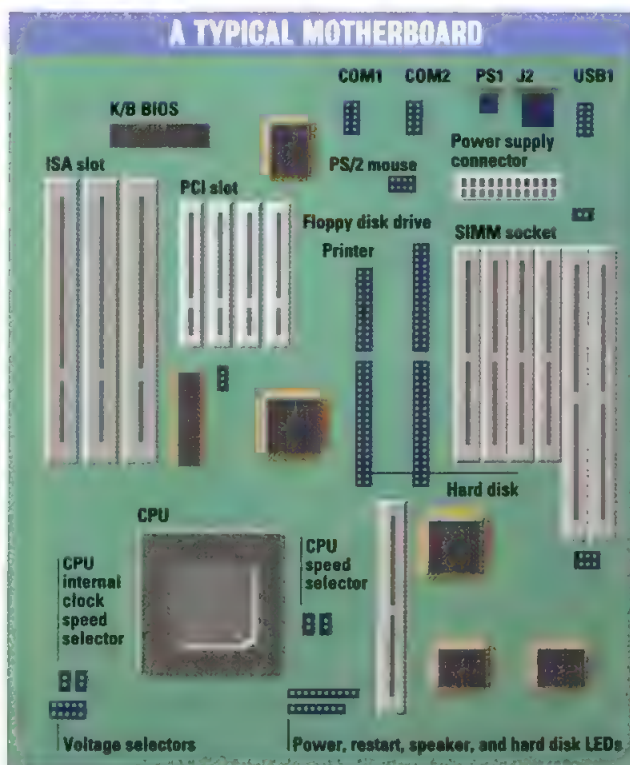


FIGURE 1: This diagram shows the location of the different components on a typical motherboard.

grades—make the undertaking very much worth the effort.

GOOD SURGICAL TECHNIQUE

1. Take your time. You probably want your upgrade in place *now*. But if hardware upgrades have one controlling axiom, it's the one about haste making waste. If everything goes perfectly, replacing a motherboard can take as little as an hour, but the chances of that happening are very slim. If you have a mission-critical deadline approaching, don't even dream of attempting a motherboard upgrade.

2. Whenever you're adding or removing a

component, remove the power cord from the computer. Experienced hardware people will tell you this isn't always necessary, but it takes only one fried chip to wreck your day.

3. If anything metal falls into the computer (a loose screw, for instance), don't turn on the machine until you get it out or you could short out your system. You must remove anything that falls into the computer; keep taking things apart until you find it.

4. You'll need a screwdriver or, better yet, a screwdriver set, with several sizes of Phillips and flat heads. Magnetized screwdrivers can come in handy, but remember not to use a magnet near your hard disks, as this can destroy the data on them.

5. Before touching any chips, ground yourself to eliminate static electricity. Wear antistatic gloves or kneel on an antistatic mat (you can get these items at an electronics store), or periodically touch a grounded piece of metal such as your computer's power supply.

STEP ONE: DIAGNOSIS AND PRE-OP

Since the whole point of this system surgery is to salvage as much of your existing system as possible, the first step is to take a physical inventory of your current system. The more thorough the inventory, the easier it will be to select new components.

Outside the Box: Most components are inside the box, but take an inventory of external parts first. The purpose is to determine how the components connect to the system. Your mouse usually connects via a serial port or a PS/2 port. A PS/2 connector is tiny (about 1/4 inch in diameter) and round, while a serial connector is either a 9-pin or a 25-pin trapezoid. Keyboard connectors come in two flavors: 9-pin DIN

(round, about 1/2 inch in diameter) and PS/2. Select your motherboard based on which type of connectors you have. You can buy adapters for keyboards and mice, but mouse adapters work only if the mouse is capable of handling both types of connectors. The best idea is to match what you already have.

The general rule is to make sure your new system will support any other external components you happen to have. If you have SCSI devices, determine whether the SCSI connection is part of the motherboard or a separate SCSI card. The same holds true for Ethernet connectors. If these devices are attached to

a peripheral card, the upgrade is easier; if they're part of the motherboard, you'll have to find a matching motherboard or buy new cards. Again, it pays to know this in advance to save frustration later.

Inside the Box: To complete your inventory and begin the actual upgrade, you'll need to open your computer case. Usually, this means removing a few screws at the back of the machine and sliding the cover away from the case (if you can find your system manual, check to see how best to remove the cover). You may need to remove the front cover as well, which usually means prying it away from the case.

Inside the case you'll see a disarray of cables. Follow these from one end to the other to see what they do. One cable will run from each floppy disk drive, another from each hard disk, another from the CD-ROM drive, and so on. These will attach either to the motherboard or to a separate peripheral card, called the *disk controller board*. Most new motherboards come with integral drive controllers, so it's quite likely that if you have a separate controller board you'll no longer need it. That's fine; removing it will free up another slot, and the more slots available the better.

The motherboard itself is the large rectangular circuit board on the bottom of the case. Figure 1 shows the layout of a typical motherboard. Yours may vary slightly, but this will give you a good idea of where the different components are located. All your peripheral cards (video, sound, modem, and such) connect to it via peripheral slots; your hard disk, floppy disk drives, and possibly CD-ROM drive are attached to it via cables (some CD-ROMs attach to the sound card instead). The CPU should be fairly easy to spot (it's a flat chip about 2 inches square imprinted with the manufacturer's name), as should the RAM modules, long and narrow circuit boards (about 1 by 4 inches) sitting partially upright in their slots. Near the front of the box you'll see a colorful menagerie of small wires attached to small connectors; these control the various indicators on the front of your computer, such as the hard disk activity light. Study the board, preferably with your motherboard manual in hand, until you know the identity of each component.

At this point, find the power supply on the motherboard. This is a big cube near the back of the case, where the power cord plugs in. Trace the two sets of wires from the power supply to the power connector on the motherboard. The standard power connector consists of two 6-pin male connectors placed end to end, and the two black wires from the

power supply attached in the middle.

The problem is that not all power supply connectors are standard (some Dell models use a different arrangement, for example). If your connectors are nonstandard, you'll have to get your replacement motherboard from the same company as your current machine or buy another power supply. In the latter case, it's probably a better idea just to purchase a new case that comes with a power supply.

Another issue is your current RAM. Until 1996, most PCs shipped with standard RAM (Fast Page Mode), but recently EDO RAM (Extend Data Out) has taken center stage. Some PCs, such as IBM ValuePoints, have used parity RAM instead (standard and EDO RAM are nonparity). These SIMMs are rarely interchangeable. Some motherboards can handle either standard or EDO SIMMs (but not both at once), but no motherboard han-

If you buy a motherboard that already contains an MMX chip, you'll be quite sure about compatibility with the chip.

dles both parity and nonparity SIMMs. If you don't know what kind of RAM you have, take the SIMMs with you when you shop for your motherboard. If you're running parity RAM, be prepared to scrap it and buy standard or EDO RAM because few new boards support parity. Finally, if your old board uses 30-pin SIMMs, an upgrade is also necessary. Over the past two years, 30-pin SIMMs have been replaced by 72-pin SIMMs, so recent boards don't have 30-pin slots.

Finally, take a look at the peripheral cards and the slots they're seated in. Your new motherboard will almost certainly ship with three or four PCI slots ($3\frac{3}{4}$ inches long) and three or four ISA slots ($5\frac{1}{2}$ inches long). Your current motherboard will have either a similar PCI/ISA combination or, if you have an older board, VLB slots ($8\frac{3}{4}$ inches long) as well. (A very old board might have ISA slots exclusively.) The trick is to have enough of the right kind of slots to accommodate your old peripheral cards. If you have a VLB card, usually a video card, you'll probably have to buy a PCI card to replace it, because few motherboards ship with VLB slots, and ISA video boards are growing scarce. Some mother-

boards have built-in video, but usually these are more expensive and less versatile than a separate motherboard and video card.

You're still not quite ready to rip things apart. First, restart your computer and view your CMOS settings (usually this means watching the boot process carefully and pressing a specified key when prompted). Look in the resulting screen for information about your hard disks. If you see cylinder/head information, copy it down very carefully. New motherboards usually recognize hard disks automatically, but if you're using an older drive you may have to type in the numbers.

With all these preparations completed, it's time to buy your motherboard. Look in your phone book for a place that sells computers, computer hardware, or computer supplies, and call with your shopping list.

If you buy a motherboard that already contains an MMX chip, you'll be quite sure about compatibility with the chip. If you're buying the chip and the board separately, make certain that your motherboard has support for CPUs with MMX technology, including a voltage regulator with a 2.8V setting. Be specific about this when buying the board, and don't take "I'm pretty sure it does" for an answer.

Get a board with at least three PCI and three ISA slots; the more the better. If you have a PS/2 mouse or keyboard, look for a board with these connectors; if you can't find one, buy a keyboard adapter and a serial mouse (or adapter). Be sure that the RAM sockets on the new board can handle the SIMMs you currently own. Also be sure that the power supply from your current machine will fit the connectors on the new board. If it won't, be ready to buy a new power supply or a new case that comes with one.

The rest of this column assumes that all you need is a new motherboard, and that the case and power supply are fine. The companion piece to this column on the *PC Magazine* Web site, however, gets into replacing your entire case. If you need to remove the power supply, you can do so simply by unscrewing it and removing it from the case. It's often easier to buy a new case with a power supply built in, especially since most such arrangements provide 250 to 300 watts. That's probably more than you have now if you're upgrading an older machine.

STEP TWO: THE OPERATION

Now it's time to replace the motherboard. Basically, it's simple: Pull all the wires and cables off the old motherboard, take out the RAM, then remove the board itself. Put the new board in its place, reseat the RAM, re-

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place the power supply and reattach the wires and cables. The trick is keeping track of what you've moved or removed, so that you can put everything back in place exactly as it was. It's a good idea to take notes and to label everything you touch with masking tape.

The first step (after removing the power cord from the case) is to clear the motherboard for removal. This will probably mean removing your floppy and hard disk drives, or at least getting them out of the way. You'll also have to pull all the peripheral cards out of their slots. Remember to take notes on where these components came from.

The next clearing stage is the removal of cables and wires, and here the important part is to label all the items clearly so you can attach them later. Be certain to label the orientation of the cable with the component. In the case of hard disks, for instance, the red wire on one edge of the cable belongs to pin No. 1 on both the hard disk and the controller (either the controller card or the connectors on the motherboard). Probably the most trying task is removing the small LED wires near the front of the board; label according to wire colors and their respective pins. Taking careful notes of these points now is far faster than the good old trial-and-error method later.

Once the board is clear, it's time to remove the screws that hold it in place and draw out the board itself. This is a good time to get rid of the dust that inevitably has accumulated inside the case. You can do this with either a *small vacuum* (not your shop-vac!) or a can of compressed air, or simply by blowing.

The RAM SIMMs will be easily accessible now, but be careful removing them. Usually, a SIMM is held in its slot by tiny metal latches at each side; removal means pulling these latches away from the SIMM until it comes loose. Once the SIMMs are removed, you can install them in the new board immediately. They fit only one way (if you examine them you'll see a tiny "ledge" in one corner), and this is no time for elbow grease. Be gentle.

With SIMMs in place and the board still out of the case, it's a good time to connect the LED wires. One important point to keep in mind is that new motherboards rarely support such archaic items as the Turbo switch. Once you've given this task your best shot, the next step is to screw down the new motherboard and begin the process of reconnecting cables and peripherals. Start with your drives (floppy disk, hard disk, CD-ROM), then insert your video card. At this point, unless your boot drive is of the SCSI variety (and

thus requires a separate controller card), it's time to boot up and test. If everything works, you can replace the other peripherals (sound card, modem, and so forth) and try it again.

Sometimes a new system won't work exactly as it did before, probably because the operating system has not recognized the new hardware. In Windows 95 or Windows NT 4, you'll want to run the Add New Hardware applet from Control Panel and see if it corrects the problem. If this fails, or if you're running Windows 3.x or NT 3.51, reinstalling Windows should help. And if any of your major applications don't work perfectly, consider reinstalling them as well, if only to refresh the Registry (in Windows 95 or NT 4). This gives your upgraded system the best possible chance to strut its stuff. Good luck!

Note: A companion piece to this column appears on the *PC Magazine* Web site (www.pcmag.com). There you'll find a complete guide to replacing your motherboard, complete with actual photographs of the operation. Viewer discretion is advised. □

Neil Randall is the author of The Soul of the Internet, published by International Thomson Computer Press, and a frequent contributor to PC Magazine.

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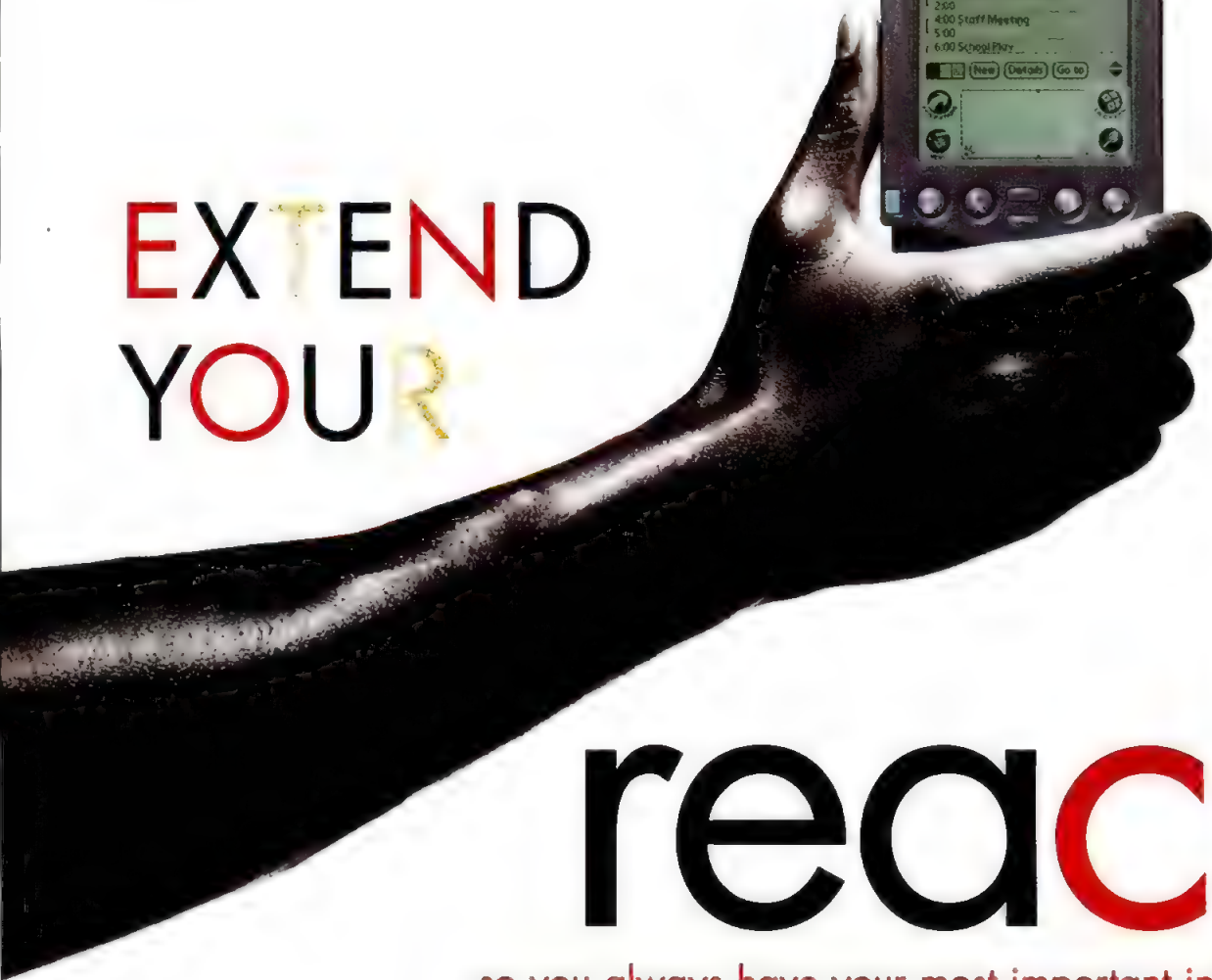
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Leaning Toward Linux

Powerful, robust, and free, Linux is worth investigating, especially if you plan to set up an Internet domain.

By Neil Randall

The more you explore the Internet, the more you hear about Unix, the powerhouse operating system on which much of the Internet was originally developed. Unix sounds intriguing, but who wants to pay for another operating system, not to mention an expensive workstation to run it? But what if you could try it out for free, right on your PC?

In fact, you can. A free clone called Linux (pronounced LIH-nuks, it rhymes—almost—with *pinups*) has become the Unix of choice not only for individual users but also for a growing number of businesses. Why? Because Linux is a multiuser system with full preemptive multitasking capabilities, and it runs the important Unix tools, applications, and protocols, such as TCP/IP, the pine and elm e-mail clients, the vi editor, Emacs, TeX, and—perhaps most importantly—the graphical X Window system, which ships with Linux in a free version called XFree86.

Linux was introduced in 1991 by Linus Torvalds (hence the name Linux), then a student at the University of Helsinki in Finland, who made the entire project, source code and all, available on the Internet for anyone to hack. And hack they did. Over the years, hundreds of programmers added to the code, changed what needed to be changed, and built in support for all kinds of hardware, especially Intel-based machines. In fact, while there are versions of Linux for several hardware platforms, the most interest has been among PC owners who want Unix but not the cost of a workstation.

Linux is covered under the Free Software Foundation's GNU Project General Public License, which allows authors to hold copyright (Torvalds is the copyright owner of the Linux kernel) but also demands that all source code for the software be publicly available for massaging by other developers. Modified software can then be sold or given away by these developers, but they too must make the code available. This explains why commercial versions of Linux—Redhat and Debian, for example—are also available via download for free. Commercial Linux distributors make money by adding value—in the form of additional utilities—on their CD-ROM versions. And many users would rather buy a CD-ROM than download a few hundred megabytes of files.

Why use it? Linux is a multiuser system, which means that it's superb as a networking environment. Unix was designed from the ground up with networking as its core, so this isn't surprising. In addition, all kinds of Unix software are available on the Internet for download, including some of the most powerful servers, so if you're looking to set up an Internet domain, Linux is a perfectly valid (and inexpensive) way to go. Furthermore, Linux's support of X Window lets you use most of the X applications out there on the Internet, including, among others, the Mosaic and Netscape browsers. Yes, you can get these with Windows, but typically your entire Internet experience will be faster through Unix. Fascinating and free X applications are being developed constantly, so you'll never run out of programs with which to work. Besides, in running Linux you're also supporting something for which the Internet

called Where to Get Linux will take you to a site showing the FTP sites for the main Linux distributions.

Technically, Linux consists only of the operating system kernel. But Linux has come to mean the kernel plus a big bundle of applications, utilities, libraries, and documents. Together, the kernel and the bundle are called a *distribution*. The Slackware distribution is the best known and can be found at <ftp.cdrom.com/pub/Linux/slackware>. Mac users can get the MkLinux distribution from <ftp.mklinux.apple.com/pub>. More recent major distributions include the Debian (<ftp.debian.org/debian>) and RedHat (<ftp.redhat.com/pub>) distributions, both of which are commercially supported, and both of which offer a friendlier interface for installation than Slackware's. All distributions are mirrored on the Sunsite archives at <sunsite.unc.edu/pub/Linux> and several other FTP sites.

All distributions of Linux are available on CD-ROM, but you can get them directly from the Internet instead. There are two ways to do this. The first option is to FTP the entire distribution to your hard disk, then install Linux from that drive. Or, if you're connect-

ed to the Internet via a machine with a fixed IP address (that is, you've set up a fixed IP in your TCP/IP configuration), you can actually install Linux over the Internet. This is recommended only for those with high-speed Ethernet access, because it means transferring between 100MB and 400MB of files. But it works, and it guarantees that you have the latest version of your distribution.

Initially Unix, and therefore Linux, seems forbidding, especially compared with the nice, friendly, plug-and-play Windows 95 environment. And,

make no mistake about it, Linux is hardly a beginner's dream scenario. But it's not as difficult to install and use as the buzz might suggest, and the fact that it's free counts for a lot. Besides, knowing Unix can't be a bad thing for your career, and Linux makes learning the popular OS more comfortable than you might think at first.

That said, don't even consider trying to install or use Linux unless you have a good grounding in, at the very least, DOS. Installing Linux demands a great deal of patience, primarily because typically you'll have to retry several times. Once it's installed, you'll find yourself, at least temporarily, in the text-only

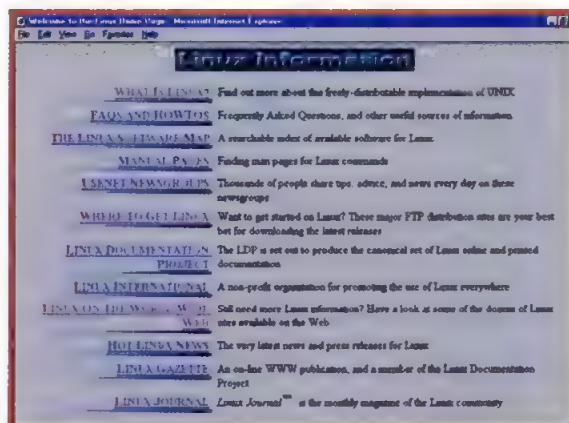


FIGURE 1: The Linux Information Page is the place to start if you're interested in exploring this flavor of Unix.

was initially designed: the collaboration of intelligent people on freely distributable tools. Aside from its power and sophistication, Linux quite simply makes you feel good.

FINDING OUT

The best place to find information about Linux is, not surprisingly, the Internet. Your first stop should be the Linux Information Page at www.linux.org (Figure 1), which will give you access to the ongoing Linux Documentation Project, FAQs, and how-to files; the *Linux Gazette* online magazine; Linux press releases and information; and other Linux sites on the Web. In addition, a link

PCTech Operating Systems

world of Unix, with a set of cryptic commands that may very well have you waxing nostalgic about your old C: prompt. The installation procedure is arcane at best, even for the friendliest packages (Figure 2). For all of these reasons, your best bet is to pick up one

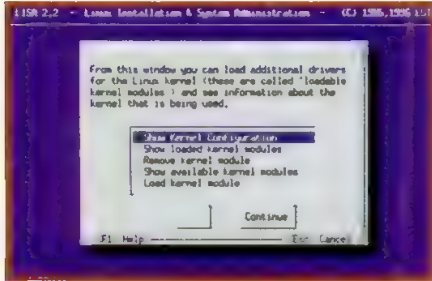


FIGURE 2: *Installation can be daunting at first, especially for those used to a graphical system.*

of the Linux books in your bookstore, some of which benefit you not just by showing you how to install and use the OS, but by carrying at least one full Linux distribution on an enclosed CD-ROM.

GETTING STARTED

You begin a Linux installation by making a drive partition available for Linux's own use. You'll want to clean off an entire partition, such as your D: drive, in preparation. It is possible to install Linux to a DOS partition through the UMSDOS file system, but this is still experimental and is potentially damaging to PCs running Windows 95. (Linux can read DOS partitions, by the way, but the reverse is not true.) Next, write down the names, models, and hardware settings (IRQs and so forth) of your hardware. Windows 95 users can get the hardware information from the Device Manager in Control Panel, DOS and Windows 3.x users from the CONFIG.SYS and AUTOEXEC.BAT files. You should have a 1.44MB floppy disk drive as your A: drive; format two 1.44MB floppy disks (it's possible to install from 1.2MB floppies, but not recommended). Next you need to write the appropriate boot-disk image to one floppy disk and to write the appropriate root disk, RAM disk, or supplementary image—different distributions give them different names—to the other. Some distributions, such as RedHat 3.0, require three disks: a boot disk and two RAM disks. You'll find the relevant information on your Linux CD-ROM or the FTP site, usually in a file called something like Install.txt. In fact, read all the .TXT files you can find, because they all contain potentially indispensable information.

It may seem odd to focus so strongly on the floppy disk preparation, but except for the in-

stallation of XFree86, it's probably the most trying part of the process. There's no setup icon in Linux, and you have to do most of the work yourself. Your first task is to locate the appropriate boot disk image for your hardware. In order to do this, you need to know how your PC is configured: whether it uses an IDE or a SCSI CD-ROM drive, and whether that CD-ROM is a special model. Linux doesn't do plug-and-play, and while it probes for equipment, it can't do anything if you don't give it the right boot disk to get started. You then need to create the root disk, RAM disk, or supplementary disk. Both of these disks are created with a DOS utility called rawrite, which is always packaged with the distribution.

Once these disks are created, the fun begins. You restart your machine with the boot disk in A:, then watch as Linux starts up. If all goes well, it will ask you for your RAM disk, or Disk 2, or whatever it's called (often not what you labeled it), and then, eventually, you will get to a login: prompt. The system will tell you to log on with the user name *root* to get started, after which you must create the two required Linux partitions (called Swap and Native) using fdisk. There are prompts to help you create the partitions, but be careful that you don't destroy your DOS/Windows partition in the process and lose all your data files. Once the Linux partitions are in place, typing "setup" will bring up a very DOS-like menu, and as long as you read the prompts carefully, the procedure should go relatively smoothly.

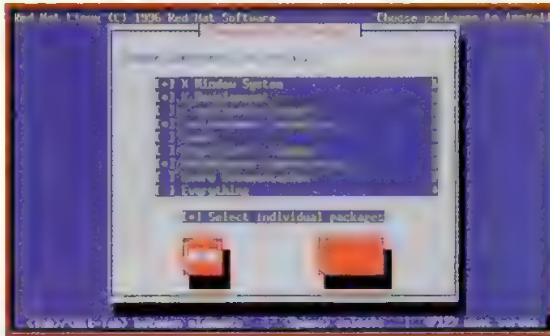


FIGURE 3: Each distribution of Linux comes with a series of software packages containing a number of different applications and tools.

You must activate the Swap partition using `addswap` and `mkswap` and then format the Linux Native partition to hold the actual OS. At that point, specify your source (CD-ROM, hard disk, tape, or Internet), and then follow the prompts until you get a chance to select the packages you wish to install.

THE PACKAGES

Each distribution of Linux comes with a series of software packages, and at installa-

tion time you choose which to install on your system (Figure 3). Each package contains a number of files, including applications, utilities, tools, and other binaries. The packages are given letters and abbreviations to help you decide, but the setup menus for the major distributions guide you through the packages quite well. You have no choice about installing the *a* package, which contains the Linux system files and shells, but beyond that it's up to you. It's a good idea to install a fairly basic system first, then rerun setup or use a program called *pkgtool* to install the rest later.

Packages range from *ap*—which contains text-based applications such as text editors, help pages, and even an audio CD player—to *d*, which includes program development tools. The *n* package gives you networking tools and applications such as TCP/IP, PPP, newsgroup readers, and the popular e-mail clients pine and elm. Package *e* gives you the Emacs word processor, while *t* contains the popular text formatter TeX. The *x* series of packages gives you the entire X Window environment, including applications such as terminal programs, spreadsheets, games, graphics editors, and development tools. You select all these from the setup menu (including individual programs if you wish), and then install does the rest.

The final stage is configuring LILO, Linux's boot manager. Once LILO is installed, it's the first thing you see on your screen when your machine boots, and you use it to launch either Linux or DOS/Windows (or another OS, such as OS/2, if you have one).

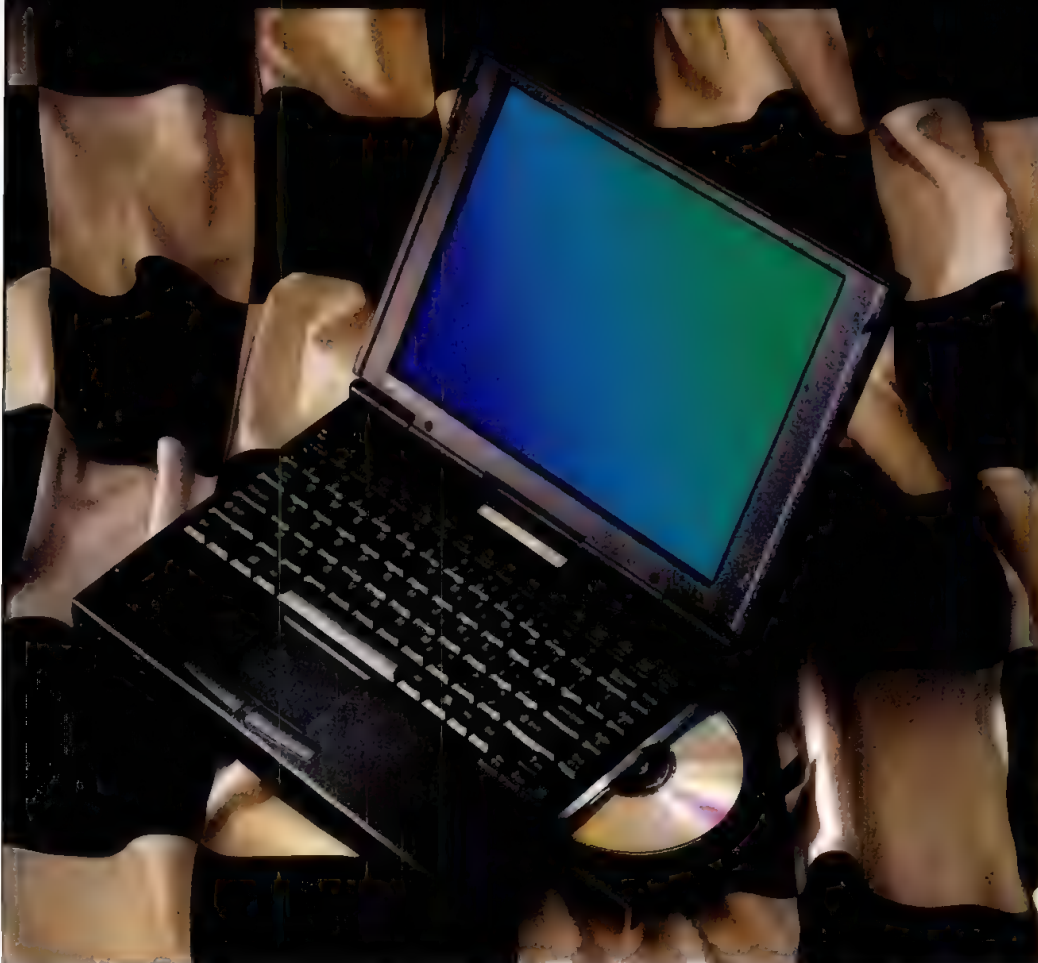
If you have installed XFree86, you're ready for the most difficult task of all, configuring X Window, but that's a subject for another column. For now, just reboot your machine, select Linux from the LILO prompt, and wait until the login: prompt appears. Type *root* and you're into the system. At this stage you'll want to learn how to find your way around Unix, then run a few pro-

grams and see how it goes.

HARDWARE NOTES

Linux gives PC owners an extremely fast and powerful Unix system. It supports a constantly increasing number of PC-based CD-ROMs, SCSI adapters, Ethernet cards, video accelerators, and sound boards, as well as the ISA, EISA, VLB, and PCI buses. It runs on as little as 2MB of RAM, although, as with all operating systems, the more RAM

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the better. A full set of packages, including X Window, runs just fine on a 486 with 16MB of RAM and a 540MB hard disk, which means you can still get some use out of your old machine.

In fact, your old machine might very well be your best bet, for several reasons. First, as mentioned above, Linux needs two disk partitions of its own, a small one for swap files and a large one (at least 300MB, realistically) for the operating system, utilities, and applications. Most of us have no unpartitioned space on our disks, and while programs such as Partition It and the freely available FIPS make it possible to repartition, we're usually reluctant to do so except on a secondary machine. Linux also wants the first or second partition of a disk for installation so that it can automatically boot from that disk, and many users' machines have multiple partitions that can't be changed.

The second reason for using an older machine is that while Linux developers work very hard to insure support of all PC-based hardware, a newer machine means there's a reasonable chance that something on your system won't be supported. That's especially true of video cards and monitors, which present the single greatest obstacle to Linux installation. Text-based Linux itself runs on any standard VGA card and monitor, but X Window can be notoriously difficult to configure with anything other than industry-standard video hardware. Other difficulties come with less common CD-ROM drives and controllers.

The best favor you can do yourself if you're contemplating Linux is to use well-known equipment such as SMC or 3Com networking cards and ATI, Diamond, Hercules, or S3 video cards. If you've just bought a great new 3-D video card, for example, there's a very real chance you can install Linux but you won't be able to run X Window. Your Linux CD-ROM should provide most of the compatibility information you need, but for the most up-to-date advice, visit an FTP site that contains your distribution.

Now you've installed a full Unix-based operating system, and anything Unix can do, you can do as well. You have everything you need at your disposal, but unless you already know Unix, Linux is anything but a quick learn. In the next issue we'll take the next step, with a discussion about basic Unix, running programs, and installing and using X Window. □

Neil Randall is a frequent contributor to PC Magazine.

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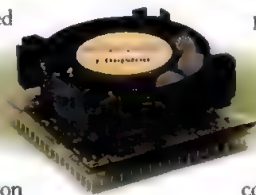
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ATL Can Mean Fast, Lightweight Controls

Version 2.0 of ATL lets you create visual ActiveX controls with multiple threads and subclassed controls.

By John Lam

Size matters. So does speed. Recently there has been a disturbing trend toward the use of large class libraries that implement every conceivable feature a programmer might want to include in an application. Unfortunately, users have paid for quicker development turnaround times by being stuck with fatter, slower applications.

The rapid adoption of the Internet as a new medium for software distribution has emphasized the need for smaller applications. Since ActiveX controls are the ideal candidates for distributing small blocks of self-contained functionality, developers have been reexamining the methods they use to create ActiveX controls.

The Active Template Library (ATL), Version 2.0, a significant upgrade to Version 1.1, plays an important role in the quest to improve ActiveX development. Whereas the previous version included support only for non-visual ActiveX controls, ATL 2.0 adds wizard support for creating visual ActiveX controls. An Object Wizard lets you create a fully functional skeleton control that has support for stock properties, single- and multiple-threaded apartment threading models, and subclassed Windows controls.

ATL 2.0 ships with Visual C++ 5.0. A version that works with Visual C++ 4.2b is also freely available for download from www.microsoft.com/VISUALC/prodinfo. The only difference between the two versions of ATL is in their wizard support, which is enhanced in Visual C++ 5.0. Both versions generate your ATL ActiveX controls using the same set of source code files.

OUR TEST-BED ACTIVEX CONTROL

This column will take you on a tour of the reference ActiveX control created for "Creating Component Software Gets Easier" (*PC Magazine*, April 22, 1997). The reference ActiveX control is a text box that fires an event whenever the input focus leaves the control. The code in the user-defined event handler sets a Boolean variable to TRUE or FALSE, and if the latter, the control changes its background to a user-defined error color.

The ActiveX control uses a custom proper-

ty of Component Object Model (COM) interfaces. But don't let that discourage you. We can simplify our discussion by grouping them into the following categories:

- **UI management** includes interfaces that manage interactions between user, container, and ActiveX control.
- **Method invocation** includes interfaces used to invoke methods on an ActiveX control.
- **Container event management** includes interfaces used to trigger events in the container.
- **Property manipulation** includes interfaces that allow user, container, and ActiveX control to interact with properties.

Figure 1 is a graphical representation of these interface groups.

The UI management group contains interfaces for instructing a control about how and when to draw or activate itself, as well as notifying a control of changes to its container's state.

Typically, the calling application invokes a control's methods directly. This does not

require any coordination between the control and the container, since the application makes direct calls to the control's IDispatch or dual interface.

The container handles a control's outgoing events using the interfaces in the container event management group. The container uses the control's type information to generate a compatible IDispatch or dual interface to receive event notifications from the

control. The control calls the appropriate interface methods to fire events. It is the container's responsibility to map these calls to the appropriate event handlers in the calling application.

The property manipulation group contains interfaces that allow a control to expose its properties. For example, you may want a control to enumerate the OLE DB data providers on a user's computer before presenting them in a list. Typically, an ActiveX property page object that manipulates the control's properties through these interfaces implements this kind of functionality.

Clearly, this is a very brief overview of the ActiveX control architecture. For further in-

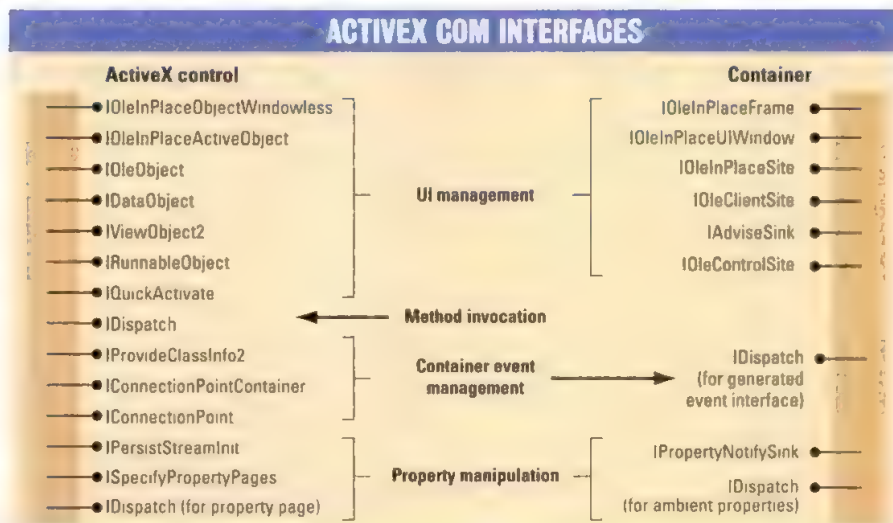


FIGURE 1: An overview of the interfaces ActiveX controls use for interaction with their containers.

ty and a custom event. Our custom property stores the color that indicates the error condition. Our custom event passes two parameters to the calling program when the keyboard focus leaves the control. The first is the contents of the text box as a string, and the second is a Boolean value that lets the control know whether its data is valid. If the Boolean is FALSE, the control sets its background color to the error color. If the Boolean is TRUE, it sets its background color back to the original background color.

ACTIVEX CONTROL ARCHITECTURE

ActiveX controls communicate with their host container through a bewildering number

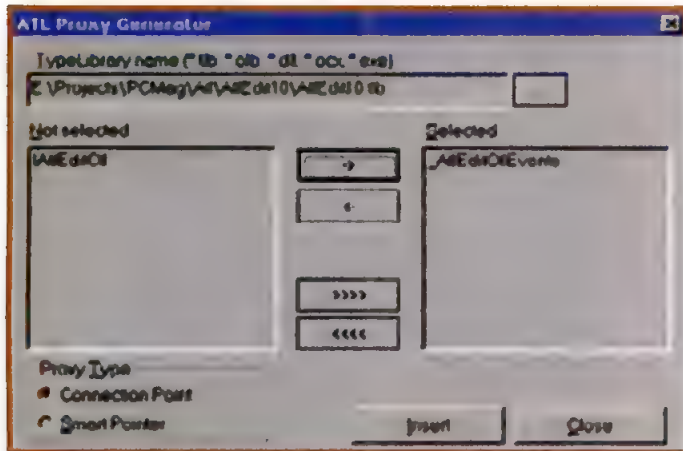


FIGURE 2: The Proxy Generator is used to generate a C++ class that encapsulates an outgoing interface.

formation, please see the references at the end of this column.

BUILDING OUR ACTIVEX CONTROL

Before we begin our tour, we'll use the ATL wizards to create a new skeleton control that does the following:

- implements the Font, BackColor, ForeColor, and Text properties;
- uses the single-threaded apartment threading model;
- subclasses a Windows Edit control; and
- implements a color stock property page.

We use the ATL Project Wizard to create a new ATL project and use the Object Wizard to create a control with the features we want. ("Creating Component Software Gets Easier," in our issue of April 22, 1997, gives an in-depth discussion on how the ATL wizards work.)

Once you have created your skeleton ATL control, you can then compile and test it in your favorite container. A good test container is Visual Basic 5.0 Control Creation Edition, which you can download for free from Microsoft's Web site (www.microsoft.com/vbasic).

Once you have a skeleton control, how do you build on the foundation and create the specific control you want? The best way to understand a complex piece of code is to break it up into sections. We will look at how properties are implemented, how events are generated, how a control makes its state persistent, and how it draws itself.

In the course of the following discussion, I'll give you code snippets that you will add to your ATL project, but space conditions preclude showing where in the files they should go. For details—and plenty of comments—you can download the complete source code from PC Magazine Online (see

the sidebar "Getting the Files," at the end of the Utilities column, for details).

PROPERTIES

Developers using your control will interact with it primarily through its stock and custom properties. The ActiveX SDK already defines the behavior of stock properties. These include the BackColor, Font, and Picture proper-

ties. The behavior of custom properties is left for you to decide.

We used the Object Wizard to select the stock properties for our control. The wizard uses the ATL `IStockPropertyImpl` class to provide the default implementation for the four stock properties in our control: ForeColor, BackColor, Font, and Text.

Unfortunately, creating custom properties is not quite so easy. ATL 2.0 does not yet provide wizard assistance for the creation of custom properties. If you want to add custom properties to our control, you're going to have to roll up your sleeves and edit some Interface Definition Language (IDL) code. Fortunately, this is not as difficult as it may seem. All you have to do is cut and paste and modify some of the IDL that has already been generated for you by the ATL wizards.

Our test-bed control uses a single custom property, ErrorColor. To add it to the control, we place the following lines into the IDL file that was generated for us by the Object Wizard:

```
[propput, id(0)] HRESULT
    ErrorColor([in]OLE_COLOR clr);
[propget, id(0)] HRESULT
    ErrorColor([out,retval]OLE_COLOR*
        pclr);
```

The above code is very similar to the code that ATL generated for our stock properties. Notice how our ErrorColor property is actually implemented as a pair of get and put functions.

Microsoft's IDL compiler (MIDL) takes our IDL file and creates a type library file. Our control's container will use this type library to determine what properties are supported by our control.

MIDL also generates the appropriate C++

header declarations for these properties in our code. Our property put and property get methods are defined as `put_ErrorColor` and `get_ErrorColor`. Now we just have to add the following lines of code to implement our custom ErrorColor property:

```
OLE_COLOR m_clrErrorColor;
STDMETHOD(put_ErrorColor)( OLE_COLOR
    Color )
{
    m_clrErrorColor = Color;
    return S_OK;
}
STDMETHOD(get_ErrorColor)
    ( OLE_COLOR*
    pColor )
{
    *pColor = m_clrErrorColor;
    return S_OK;
}
```

Finally, we add the following entry to our ATL control's property map:

```
PROP_ENTRY("Error Color", 0,
    CLSID_StockColorPage )
```

The property map is used to bind a property to a property page, as well as to instruct ATL to provide a default persistence implementation. ATL also provides an implementation for a stock color property page; all you have to do is add its class ID to your property entry.

EVENTS

Implementing events requires a little more work. Most of it is simple bookkeeping, making it an obvious candidate for automation in future versions of the Object Wizard (or an Interface Wizard).

First, you must define your outgoing interface and event in your control's IDL file:

```
[
    uuid(B5C629A1-76B7-11D0-BC62-
        00A0243ABE0B), helpstring("Event
        interface for AtlEditCtl")
]
dispinterface _AtlEditCtlEvents
{
    properties:
    methods:
    [id(1)] void Validate([in]BSTR
        Text,
        [out]VARIANT_BOOL* Valid);
};
```

The important line is the one that defines our `Validate` event. We are passing a string



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parameter (OLE Automation strings are known as BSTRs, or Basic strings) by value, and a Boolean parameter by reference. The [in] and [out] modifiers signify pass-by-value and pass-by-reference, respectively. Once you have finished editing the IDL file, compile the IDL file from within Developer Studio.

The third wizard included with ATL is the Proxy Generator (Figure 2). It reads a type library file and generates C++ code to fire events on our outgoing interface. In the sample control, we have used the Proxy Generator to create a new class called `CProxy_At1EditCtlEvents`.

Your control must derive from `CProxy_At1EditCtlEvents` and `IConnectionPointContainer` to add support for outgoing event interfaces. Just add the following two lines to your control's inheritance list:

```
public CProxy_At1EditCtlEvents
<CA1EditCtl>,
public IConnectionPointContainerImpl
<CA1EditCtl>
```

Add the following line to add the `IConnectionPointContainer` interface to the list of those supported by your control.

```
COM_INTERFACE_ENTRY_IMPL
(IConnectionPointContainer)
```

ATL's `IUnknown` implementation takes care of mapping all `QueryInterface` calls to the appropriate class that implements an interface—as long as there is a corresponding entry in the interface table for that class.

Finally, we add a new connection-point map:

```
BEGIN_CONNECTION_POINT_MAP
(CA1EditCtl)
    CONNECTION_POINT_ENTRY
        (DIID_At1EditCtlEvents)
    CONNECTION_POINT_ENTRY
        (IID_IPropertyNotifySink)
END_CONNECTION_POINT_MAP()
```

Connection-point maps are used by ATL's implementation of the `IConnectionPointContainer` interface. `IConnectionPointContainer` is the interface that the control's container uses to find out what outgoing interfaces our control supports. ATL's implementation of `IConnectionPointContainer` uses the map to return the control's outgoing interface to its container.

With all of the bookkeeping finally out of the way, we can finally turn our attention to writing the code that actually fires the event.

When a user causes the focus to shift away from a particular window, Windows sends a `WM_KILLFOCUS` message to that window. To handle this message, we add the following to our edit control window's message map:

```
MESSAGE_HANDLER(WM_KILLFOCUS,
OnSubclassKillFocus)
```

We can install our own handler for the `WM_KILLFOCUS` message:

```
...
Validate( Text, &Valid );
// fire the actual event

if( Valid )
{
    m_clrBackColor =
    m_clrCurrentBackColor;
}
else
{
    m_clrCurrentBackColor =
    m_clrBackColor;
    m_clrBackColor =
    m_clrErrorColor;
}
FireViewChange();
...
```

By checking the `Valid` parameter, our control can determine whether its contents are valid. If they are, this code sets the control's color to the current background color of the control. If the control's contents are not valid, it sets the control's color to the color specified by the `ErrorColor` property.

PERSISTENCE AND AMBIENT PROPERTIES

A control must be able to save and load its properties to and from persistent storage. After a user finishes setting all of our control's properties at design time, he will probably want to save his work to a file. When a user compiles an application, the compiler needs to save the control's properties to the executable file. In both cases, the control's container will have to ask the control to save its properties to an `IStream` interface that it provides.

All of our control's properties are already persistent, since ATL provides default persistence support through its property-map mechanism. Recall how we added an entry for our `ErrorColor` property in ATL's property map? You also made `ErrorColor` persistent at the same time. However, if you have custom properties that cannot be mapped using ATL's generic property map mechanism, you will have to add your own code.

An ActiveX control's persistence is managed by the `IPersistStreamInit` interface. Its member functions `Load` and `Save` handle loading and saving a control's properties through an `IStream` interface provided by the control's container. Below is our control's implementation of `Load`.

```
STDMETHOD(Load)(LPSTREAM pStm)
{
    HRESULT hr;
    hr = IPersistStreamInitImpl
    <CA1EditCtl>::Load( pStm );
    if( FAILED( hr ) )
        return hr;

    // Your custom persistence code
    // goes here

    return S_OK;
}
```

The boldfaced line calls ATL's stock property persistence implementation first. If you want to add your own custom persistence code, you must add it after ATL has had an opportunity to load its properties first.

When you create a new control by dragging and dropping it from the tool palette, the new control's properties must be initialized from scratch. A well-behaved control should initialize some of its stock properties by querying the container for its ambient properties.

You should implement this one-time initialization code in the `InitNew` member function of `IPersistStreamInit`. I have excerpted a few lines from our control's `InitNew` to show you how to query a control container for its ambient properties. The functions `GetAmbientBackColor` and `GetAmbientForeColor` are both implemented for you by ATL:

```
if( SUCCEEDED( GetAmbientBackColor
( clrBack ) ) )
    m_clrBackColor = clrBack;
if( SUCCEEDED( GetAmbientForeColor
( clrFore ) ) )
    m_clrForeColor = clrFore;
```

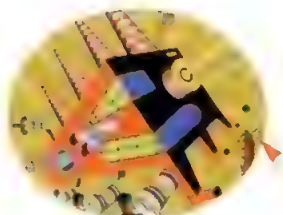
DESIGN-TIME VS. RUN-TIME BEHAVIOR

Your ActiveX control will exhibit different behavior depending on whether it is in a design-time environment or a run-time environment. In the case of our ActiveX control, the Edit window is not actually instantiated at design time by a container such as VB4. During design time, we must draw the way the control will appear in the run-time environment, so that the user can use the vi-

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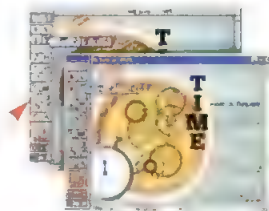
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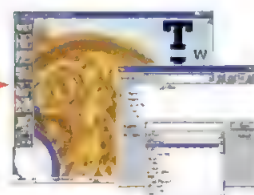
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PCTech Power Programming

sual feedback to design a user interface.

I handle this in our control's OnDraw event handler. I use the Win32 DrawEdge function to draw our control's bounding rectangle, and I paint the text contained in our control's Text property using the font specified by our control's Font property. (For details, see OnDraw in AtlEditCtl.cpp.)

WINDOWS CONTROL MISCELLANY

You may be wondering how our ActiveX control actually sets our edit control's foreground and background colors. When a Windows Edit control is about to paint itself, it sends a WM_CTLCOLOREDIT message to its parent window to ask the parent window to set its foreground and background colors. We add a handler for this message in our control's message map and drop in the following code:

```
COLORREF clrBack, clrFore;

if( FAILED( OleTranslateColor(
( m_clrBackColor, m_hPalette,
&clrBack ) ) )
OleTranslateColor(
OLE_COLOR_WINDOW_BACKGROUND,
m_hPalette, &clrBack );
```

```
if( FAILED( OleTranslateColor(
m_clrForeColor, m_hPalette,
&clrFore ) ) )
OleTranslateColor(OLE_COLOR_WINDOW_TEXT,
m_hPalette, &clrFore );
::SetTextColor( (HDC)wParam, clrFore );
::SetBkColor( (HDC)wParam, clrBack );
```

We use the function OleTranslateColor, provided by the OLE libraries, to convert the OLE_COLOR parameters to the COLORREF values required by the Win32 API functions SetTextColor and SetBkColor.

SUMMING THINGS UP

If you want to test our new ActiveX control, just drop it into your favorite container. Set the ErrorColor property to the color that you want, and add some validation code to the event handler:

```
Private Sub
VBValidEdit1_Validate(ByVal Text As
String, Valid As Boolean )

If Text = "ActiveX" then
Valid = True
Else
Valid = False
```

```
End If
End Sub
```

I hope this column has given you some insights into how you can build your own ActiveX controls from scratch. Feel free to use our model as a starting point for building your own ActiveX controls. It provides all of the requisite hooks to handle property persistence, interactions with a container's ambient properties, and custom events.

FURTHER READING

Understanding ActiveX and OLE: A Guide for Developers and Managers, by David Chappell (Microsoft Press, 1996), is an excellent overview of the various ActiveX and OLE technologies.

ActiveX Controls Inside and Out, by Adam Denning (Microsoft Press, 1997), provides a good in-depth look at creating ActiveX controls with and without MFC.

The OCX 96 specification is part of the ActiveX SDK, which you can download from www.microsoft.com/activex. □

John Lam is president of Naleco Research (www.naleco.com), developer of RADFind 96, a high-speed file finder for Windows 95.

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OpenTrap Eavesdrops on Windows

With OpenTrap, you can unravel the mystery of file-opening activity.

By Rick Knoblauch and Gregory A. Wolking

Windows 95 accesses hundreds—even thousands—of files during a typical day of use. This activity goes on behind the scenes, because you don't usually need to know about it. But when you try to launch an application and get a message such as "Can't find foo.bar or one of its components," you suddenly have a very keen interest in knowing what file Windows was trying to open.

You can guess what files are missing or call a technical support line to help track them down. But for immediate gratification, fire up OpenTrap, this issue's utility. OpenTrap watches and logs all file activity. It can show you which files were successfully accessed and, more importantly, which file open operations failed. Armed with the paths and filenames of the culprit files, you at least have a fighting chance of resolving these types of problems.

A look at behind-the-scenes file activity can be surprising. The sheer volume of file activity in the average Windows session will give you a new appreciation for the work done by Windows 95's file system. OpenTrap can help you understand why some seemingly simple operations take so long to execute. For example, simply launching Microsoft Word 7.0 *without loading a document* generates well over 300 Open and Close events. Moving a shortcut from one folder to another in the Start Menu causes Explorer to access hundreds of files.

OpenTrap can also optionally eavesdrop on file close functions. This can give you insight into how much time has been spent working on particular files—useful for billing clients. Note that many applications open the file just long enough to read into

memory or copy to a temporary file, and then close it. In this case, you have to look for the second open/close pair from when you saved and closed the file to see how long the file was in use.

You can obtain OpenTrap by downloading it from PC Magazine Online or by mail. (Refer to the sidebar "Getting the Files" for details.) The source code for OpenTrap,

OpenTrap

OpenTrap is a 32-bit Windows 95 application that lets you record file system activity so you can diagnose problems with your system or just see what's going on behind the scenes as you work.



which was written in C++ and assembly language, is also provided for those interested in seeing how it works.

USING OPENTRAP

To install OpenTrap, place its component files (Opentrap.exe, Opentrap.hlp, Opentrap.cnt, and Functrap.vxd) in the folder of your choice, then create a shortcut to Opentrap.exe. The first time you run the program, it will automatically register the .OTL extension it uses for its log files unless you already have that extension associated with another application. This lets you open or print your OpenTrap event logs directly from Explorer by right-clicking on the file. Should you

decide to remove OpenTrap from your system, follow the instructions in the online help. Other than the log files that you save to disk manually, OpenTrap neither creates nor uses any additional files.

Important note: If you also have our BigBin utility installed on your system (*PC Magazine*, June 10, 1997), you must be aware that OpenTrap and BigBin share the Functrap.vxd device driver. For both programs to work correctly, there must be *exactly one* copy of Functrap.vxd on your system. This means that you must either install OpenTrap and BigBin in the same folder along with Functrap.vxd or, if you prefer installing each utility in its own folder, place Functrap.vxd in your Windows System folder.

By default, OpenTrap launches in the idle state, ready to begin logging file events. To begin logging, use the Start Logging command on the Logging menu or click the traffic light icon in the toolbar. Select Stop or click the stop sign icon in the toolbar to stop logging and view the contents of the current log. OpenTrap will stop logging automatically if its log buffer fills. To minimize its load on your system, OpenTrap displays the log's contents only when it is idle. Each line on the screen represents one file event, described in plain English as illustrated in Figure 1. If an application fails to open a file, OpenTrap highlights the line in order to make it stand out.

OpenTrap's logs can be very large. At its maximum buffer size of 2,048K, a log can easily contain over 30,000 events. To maximize efficiency in viewing this information, OpenTrap divides the log into logical pages. The number of events per page depends on the current font, up to a maximum of 1,024. Use OpenTrap's scroll bars or the navigation keys (the arrow keys, Home, PgUp, PgDn, and End) to navigate within the current page. Use the View menu commands, the toolbar buttons, or the key combinations Ctrl-PgUp, Ctrl-PgDn, Ctrl-Home, and Ctrl-End to navigate between pages.

The Save and Save As commands let you save your logs in OpenTrap's native format. Since individual log records are interdependent, OpenTrap does not let you edit,

FOR PROGRAMMERS ONLY OpenTrap has two components: a VxD monitoring engine (Functrap.vxd) written in assembly language, and an interface for displaying file activity data (Opentrap.exe) written in C++ with MFC. The full source code for OpenTrap is available from PC Magazine Online, and it demonstrates the following programming techniques:

- how a VxD can tell which module has performed a file operation;
- ways to get around limits in the MFC window-scrolling functions;
- how to take control of MFC's standard MRU list processing.

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delete, or rearrange them. You can, however, use the Save As Text command to export a log as ASCII text (either plain text, as shown on the screen, or in comma-delimited format) for use by other programs.

The Logging Options dialog (Figure 2) lets you determine the size of OpenTrap's log

language using Microsoft's MASM 6.11 and the Windows 95 DDK. The interface portion of the program, OpenTrap.exe, is a 32-bit application written in C++ and MFC using Microsoft Visual C++ 4.0.

When Functrap was presented in the context of the BigBin utility several areas were highlighted, including dynamic loading of the VxD, communication between an application and a VxD, and the use of multiple threads. This time, we'll dig deeper into the VxD and elucidate its use of low-level services and techniques for determining which modules are performing file operations. In addition, the OpenTrap interface demonstrates how to receive information from the VxD, store it in an efficient manner, and present it to the user in easily readable form.

LOW-LEVEL PROCESSING

To eavesdrop on file opening functions, we must plug in at the system level. In DOS, a hook into INT 21h would be the obvious solution. In

Windows 95, the IFS (installable file system) manager furnishes a service called IFSMgr_InstallFileSystemAPIHook, which lets interested VxDs hook into the action. Functrap uses this service to monitor IFS Manager API function calls. When calls occur, Functrap's installed hook procedure is called with parameters that indicate the type of request, the accessed drive, and other information (through a pointer to an IFS I/O request structure).

If a particular call matches any of the ones

the VxD specifying the callback address, the IFS manager API function to be monitored, and the conditions under which to do so. (The BigBin utility column describes this in more detail.)

When it observes an IFSFN_OPEN function, Functrap must perform several steps. First, it allocates a buffer to hold the associated information using the Virtual Machine Manager (VMM) linked list services. These services provide a flexible and convenient way to allocate fixed-size memory blocks and optionally manage them in a linked list. Functrap creates a new list object as follows:

```
mov     eax, (LF_ASYNC OR
             LF_ALLOC_ERROR)
mov     ecx, (size trap_record)
VMMcall List_Create
mov     list_handle, esi
```

The LF_ALLOC_ERROR flag specifies that the list manager should return with the carry flag set, should allocation fail. LF_ASYNC indicates that elements can be allocated at any time (even during interrupt processing).

Functrap doesn't actually maintain a linked list. It simply uses the service to allocate a buffer record which it passes to OpenTrap. The information placed in the buffer includes the full path of the file being opened, the name of the module opening the file, and the error code reflecting the status of the operation. Retrieving each of these items and reporting them makes up the core functionality of the utility.

The next step is to save the pathname specified in the file open function. Functrap converts the Unicode pathname to the OEM character set and copies the converted string into the allocated buffer.

The name of the module performing the file open operation can be found in more than one location. One of the places is in the task database (TDB) for each task, which the operating system maintains in a linked list. A TDB stores a task's context, including its module name and current directory. TDBs are really artifacts of 16-bit Windows and cooperative multitasking. They

are maintained in Windows 95 Win32 processes for compatibility, however.

To obtain the module name, Functrap needs a pointer to the TDB for the currently executing task. If Functrap were a 16-bit Windows application, it could call the Get-

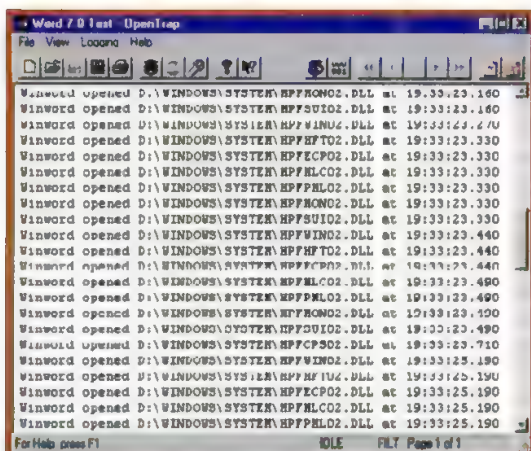


FIGURE 1: OpenTrap's main window displays logged events. Shown here are the .DLL files opened when Word 7 is launched.

buffer, the types of events it will record, and whether OpenTrap will hide itself as a system tray icon while logging. To open the main window from the tray, just double-click on the tray icon. You can save your options so that they will automatically be used each time you start the program.

The Filter Options dialog (see Figure 3) lets you control which events are displayed on the screen so that you can track activity for a specific file, group of files, application, and so on. You may also select a custom font, which OpenTrap will use for both its screen display and printed output. As with the Logging Options, the Filter Options can be saved. OpenTrap automatically saves its window size and position, toolbar layout, and font setting when you exit.

All of OpenTrap's options and settings except for custom fonts can be specified on the command line to facilitate automated operation from your StartUp folder. There is even an "Auto Start" switch that lets you tell OpenTrap to begin logging immediately after it is launched. We have space enough here to describe only the basic functions and features of OpenTrap. For further details, consult the program's online help file.

INSIDE OPENTRAP

OpenTrap gets its information about file activity from Functrap.vxd, a monitoring engine first used in PC Magazine's BigBin utility. The Functrap VxD was written in assembly

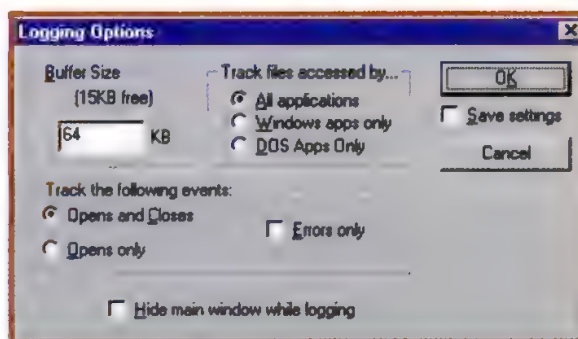


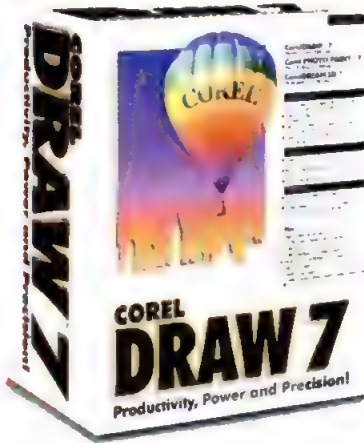
FIGURE 2: The Logging Options dialog lets you set the log buffer size and limit the amount of information that OpenTrap will record.

Functrap has been asked to watch, it reports back to the requesting application using the VWIN32 service _VWIN32QueueUserApc to perform a callback. The application (in this case OpenTrap) uses the DeviceIoControl API function to send an IOCTL command to

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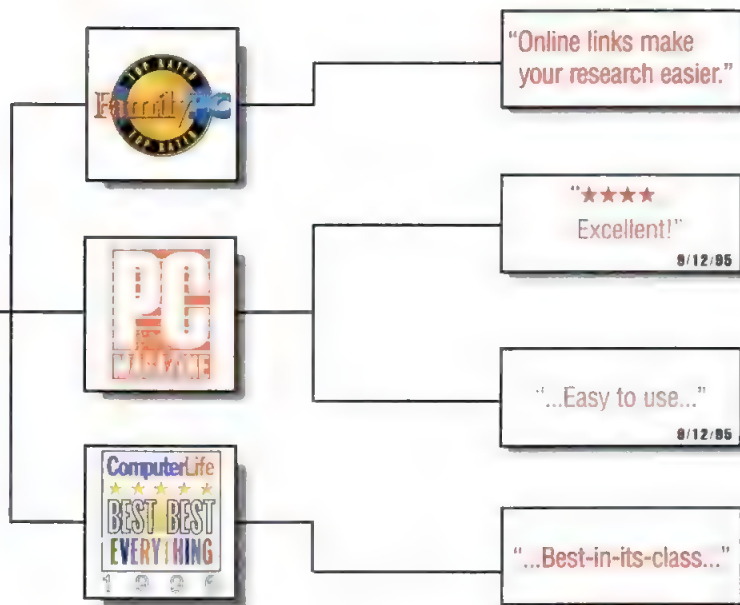
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CurrentTask function to retrieve a selector for accessing the current TDB. Being a VxD, Functrap must resort to other methods. It calls the `VWIN32_GetCurrentProcessHandle` service, which returns a pointer to the current process database (PDB).

A PDB is a kernel32 object created when a program is loaded into memory. The system uses it to track all of the items owned by the program—including memory, handles, threads, and pointers, using a linked list of data structures. Each of these data structures points to a global module table where another pointer to the desired module name can be found. But Functrap uses the simpler method of taking the name from the TDB.

Within the PDB is a field containing a selector for accessing the TDB associated with the process. Functrap retrieves the module name from there. Note that occasionally (particularly during application start-up), OpenTrap may report that the module name is unknown. This occurs when the file open API functions are issued before the system has primed the TDB with the module name. (For more information regarding these system data structures and other aspects of the Windows 95 inner workings, check out Matt Pietrek's book *Windows 95 System Programming Secrets*, IDG Books, 1995.)

The last item Functrap must retrieve is the error code for the file open function. This is accomplished by calling the previous IFS manager API function, the address of which is supplied to Functrap when it installs its hook procedure. The previous function will, in turn, call the actual IFS manager API function. When the call returns, Functrap plucks the error code from the IFS I/O request structure.

With this final piece of file information in its buffer, Functrap performs the callback to OpenTrap, supplying a pointer to the buffer as an argument. This raw data constitutes OpenTrap's activity reports, but OpenTrap has to jump through a few more hoops to present this information to the user.

THE APPLICATION LAYER

The OpenTrap interface application uses a worker thread running in the background to take the information returned by the VxD and store it in its own space-conserving buffer in memory. Each time you start logging, the `CMainFrame::StartLogging` function first does a little math to determine a safe endpoint for the log buffer. As you'll see in a minute, OpenTrap stores events as variable-length records, so there is no way to tell in advance how many records the buffer can hold. Next, OpenTrap loads `Functrap.vxd` into memory, sets up condition records to tell the

VxD which events it wants to track, then launches its worker thread. The worker thread uses a series of `DeviceIoControl` API function calls to pass the condition records to the VxD along with the address of the `our_callback` function and the worker thread's context handle. The worker thread then enters a loop, waiting for the main application to signal it to stop logging.

Once initialized, the VxD employs the worker thread's context handle and function address to call `our_callback` each time it detects one of the specified events. Since these callbacks are performed within the context of the worker thread, the main application can remain active and responsive to user input such as moving the window or getting help while logging is in progress. As it records each event, the callback function checks its current buffer position against the value calculated by `StartLogging`. When the buffer fills, it sets a flag so it knows to discard any further events and posts a message to the main window indicating that the log has filled. Since many, many file events may occur between the time the thread posts the message and the time the main window can respond, this mechanism guarantees that the logging thread will never try to write past the end of the buffer.

When OpenTrap stops logging, the `CMainFrame::Stop_Logging` function uses `DeviceIoControl` API calls to tell the VxD to release the condition records set up when logging started. Once those records are released, the VxD stops making callbacks, so `Stop_Logging` can terminate the worker thread and close the VxD's handle, allowing the system to unload the VxD from memory unless another application (such as `BigBin`) is still using it.

STORING EVENTS

OpenTrap does not require all of the data that the VxD provides. To conserve space, `our_callback` passes the raw data from the VxD to `format_log_record`, which extracts the information that OpenTrap needs and appends it to the log buffer in a more compact form.

OpenTrap's log consists of a doubly linked list of variable-length records stored sequen-

tially in a single memory buffer. Each record has a fixed portion containing pointers to the previous and next records; fixed-size data such as the file handle, function code, error code, and module name; and a pointer to the filename string. The fixed portion is followed immediately by the filename string. OpenTrap stores filenames in ASCIIZ format (ASCII text terminated by a zero byte) so the buffer only contains the filename itself, not

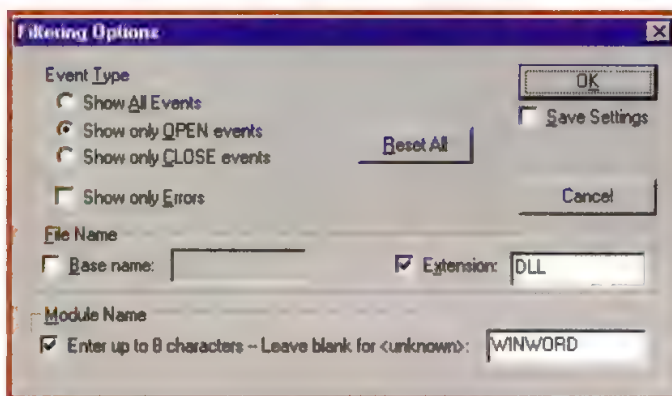


FIGURE 3: The Filtering Options dialog settings shown here were used to filter the display shown in Figure 1.

the entire 260-byte fixed-size buffer provided by the VxD.

Formatting the log data for display is fairly straightforward; a simple call to `sprintf` does most of the work. The tricky part is determining the names of files that were closed. The VxD does not report the full name of a closed file; it only reports the letter of the drive on which that file resided. To find the name, OpenTrap takes advantage of the way Windows keeps track of open files. When an application opens a file, Windows assigns it a handle, which is in essence an arbitrary 32-bit number. Once created, a given handle always refers to the same file until all applications using that handle have closed it. Once that happens, Windows destroys the handle and recycles its associated 32-bit number for use by the next application that needs to open a file.

Each time logging stops, OpenTrap walks through the log from the beginning, looking for Close events. When it finds one, it saves its place in the log and begins looking backward through the log for an Open event with the same file handle. If it finds one, it sets the Close event's filename pointer to point to the Open event's filename string. Otherwise it leaves the Close event's pointer pointing to its own string, which is always the drive letter followed by a colon. Thus, OpenTrap is able to report the names of closed files without requiring additional storage for a duplicate copy of the filename string.

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THE CSCROLLVIEW CLASS

MFC provides the `CScrollView` class to make it easier to implement a scrolling view of your application's document. You draw your document on a large virtual window, then call the `SetScrollSizes` member function to tell `CScrollView` the document's total size, and set the page and line increments for your scroll bars. Once that is done, `CScrollView` displays and monitors the window's scroll bars and displays the appropriate portion of the document in the window.

This seemed to work at first, but when OpenTrap's logs reached about 2,000 records, some very strange things started happening. Dragging the vertical scroll bar's thumb to the end of the bar would leave the window displaying events somewhere in the middle of the log, and in some cases OpenTrap would crash with a general protection fault as soon as it stopped logging and attempted to display the log.

The cause of the problem was both surprising and disturbing. While single-stepping through the MFC core code, I discovered that portions of the Windows 95 GDI (Graphics Device Interface) subsystem are still 16-bit, but the `CScrollView` class uses 32-bit integers to store its document size. When `CScrollView` tells the GDI subsystem how large your document is, it simply truncates its 32-bit values down to 16 bits. If your document's dimensions exceed the limits of a 16-bit signed integer (-32768 to +32767), that truncation causes the GDI subsystem to receive incorrect information. This is why OpenTrap divides your document into logical pages—to avoid exceeding the GDI subsystem's limits. OpenTrap sets the maximum height for a displayed page at 16,384 pixels (half the limit of the GDI subsystem), and di-

vides 16,384 by the height of one line in the current font to determine the number of lines a single page can hold. If the result is greater than 1,024 (an arbitrary value), OpenTrap reduces it to 1,024.

Scrolling speed posed another problem, especially when the display is filtered. At first, OpenTrap simply walked through the entire log, determining whether each event fit the current filter and keeping track of its physical

When CScrollView tells the GDI subsystem how large your document is, it simply truncates its 32-bit values down to 16 bits.

position in the document. If the current record fit the filter criteria and the current position fit within the current viewport (as determined by the scroll bar settings), OpenTrap drew that record on the screen. This approach worked, but the larger the log got, the more sluggish scrolling became.

So instead, OpenTrap calls `COpenTrapView::Build_Record_List` each time you either add records to the log or change your filter settings. `Build_Record_List` walks through the entire log, builds an array of pointers to those records that match the current filter criteria, and calculates the number of pages to display based on the number of matching records found. When it's time to draw the win-

dow's contents (for example, when the window is scrolled), `COpenTrapView::OnDraw` calculates the offset for the first record to be drawn using the position of the vertical scroll bar thumb, the height of a line in the current font, and the current page number. The program then walks through the pointer array and draws each record in sequence until it either fills the window or reaches the end of the log. As a result, OpenTrap never has to draw more than one screenful of records so its scrolling is very smooth and snappy, regardless of the size of the log.

There's plenty more to describe about OpenTrap's inner workings, but for reasons of space, I'll have to end this discussion here. For example, you may be interested in how OpenTrap parses its command line. MFC provides mechanisms for this, but they aren't well documented. The procedure is not difficult, and you'll find the relevant code near the beginning of the `Opentrap.cpp` source file.

In today's Windows 95 environment, application programs and the system infrastructure that supports them consist of more disk files than ever before. OpenTrap's ability to detect missing files and report which files are used can be a major help in diagnosing system problems. □

Rick Knoblaugh is a systems programmer and frequent contributor to PC Magazine. Gregory A. Wolking is the primary sysop of the ZNT:TIPS Forum on ZDNet/CompuServe and moderator of the PC Magazine Utilities discussion area on the Web (www.pcmag.com/discuss.htm).

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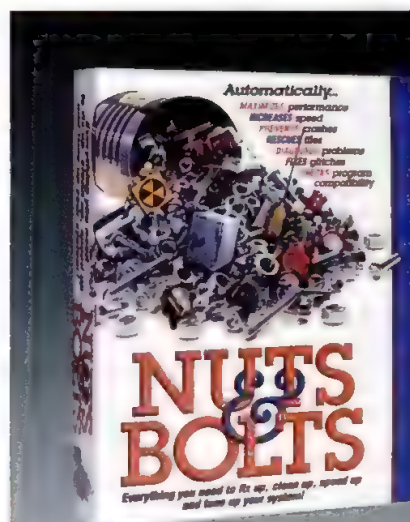
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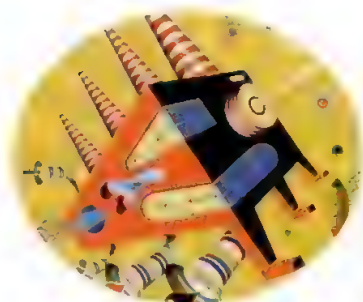
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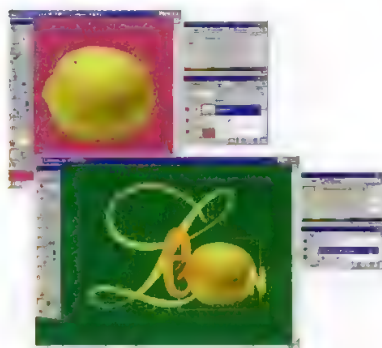


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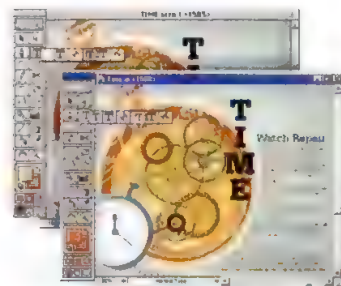
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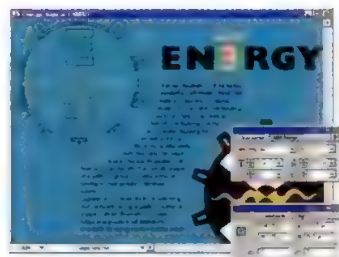
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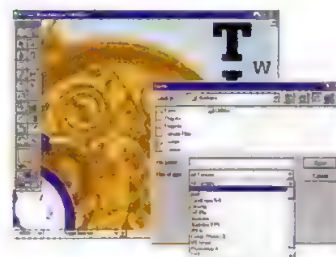
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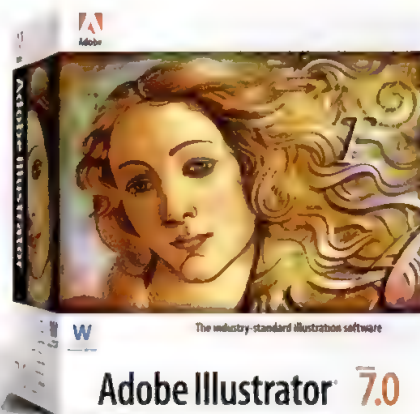
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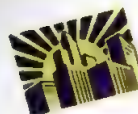
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 - Teac 1.44MB Floppy
 - Matrox Millennium 2MB WRAM 64-bit accelerator
 - Monitor - 17" Sys, high res .26 dot pitch, 95KHz refresh
 - Sys 104 key Windows 95 Keyboard
 - Microsoft serial mouse
 - Case - Tower, 8 drive bays, ATX form factor, 235W power supply
 - 12X CD-ROM Drive
 - Sound Blaster 32 PnP wavetable
 - 80W powered speakers
 - Cardinal int. 33.6K, V.34 Modem w/ 14.4 fax
 - Operating System - Windows NT Workstation v4.0 (preinstalled, with CD & docs) (Windows 95 optional)

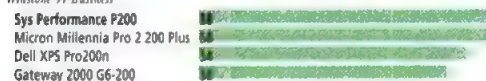
PERFORMANCE TESTS

Source PC Magazine, December 3, 1996

Winstone 97 High-end



Winstone 97 Business



Of this group of computers only the Micron Millennia Pro 2 200 Plus approached Sys' performance scores but costs approximately 20% more.



The Affordable Ultra-Portable

It's never been so easy for mobile presenters to own an Ultra-lightweight LCD projector with advanced metal halide lamp technology. Now CTX Opto introduces the EzPro 580 with true 800 x 600 SVGA resolution. With a host of new features, and a total solution package, EzPro 580 checks in at the industries' lowest price.



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- Ultra bright display *(even with the lights on)*
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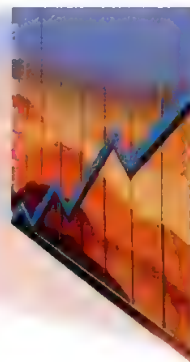
CTX Opto, Inc.

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"You plug the dog-gone thing into your laptop, and there's not much else to deal with."

May 1997, Success Magazine



U.S. Market Share:
Pentium Pro CPU



Source: IDC - December, 1996*

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It's not just a new monitor size. It's new display technology that's got everything you ever wanted in a big screen monitor — better performance, smaller footprint, even the perfect price.

The performance of the best 21" monitor.

The image quality of the new 19" SuperScan Elite 751 is every bit as good as the best 21" monitor — and in some ways better. For example, its focus is a full 30% sharper than the previous state-of-the-art. Plus it delivers brighter, richer color and improved contrast at the same time.

It's also one of the few monitors of any size that gives you *genuine* 1600 x 1200 resolution — not a simulation. And one of

	HITACHI ELITE 751	SONY 20SEII
TUBE SIZE	19"	20"
PITCH	0.22 (H) 0.14 (V)	0.25
MAX. REFRESH @ 1600 x 1200	75 Hz	75 Hz
SUGGESTED RETAIL	\$1,149	\$2,000

**THE SONY IS AN
INCH BIGGER, BUT
COSTS 74% MORE.**

*Get similar savings over other high-end
20 and 21 inch monitors as well.*

fewer still that does it flicker-free to the VESA recommended 75 Hz refresh rate.

The new tube with multi-step dynamic focus and auto-astigmatism correction is also flatter than many CRTs so it

displays a more accurate image with less distortion, even at screen edges and in the corners.

The footprint of a 17" monitor.

Look at the footprint and you're in for another surprise. The same technology that made our tube better also made it shallower — just 18.1". So it fits on narrower work surfaces.

And it's priced at just \$1,149 (SRP*)

There's one more bonus to our new 19" tube technology. It's a lot less expensive to make so it goes for hundreds less than a comparable 20" or 21" monitor.

So if you want the resolution of a big screen monitor without the bulk and price of a conventional 20 or 21, you've got to see the new Elite 751. Call for details and dealers near you.
800 441-4832.

MONITOR	TUBE SIZE (Viewable size)	PITCH (mm)	1600 HORIZONTAL PIXELS?
NEC P750	17" (15.6")	0.25 mask	NO
SONY 17SEII	17" (16.0")	0.25 AG	NO
HITACHI ELITE 751	19" (18.0")	0.22 horiz.	YES (1672)
SONY 20SFI	20" (19.1")	0.30 AG	NO
VIEWSONIC GT800	20" (18.1")	0.30 AG	NO
MITSUBISHI 91TDM	21" (19.7")	0.28 AG	NO

Beware of monitors that claim 1600 x 1200 but lack a tube that can resolve 1600 horizontal pixels. Compare screens at 1600 x 1200 before you buy.



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AMD-K6 MMX 200MHz	A113-8700	8X	1.3	\$1,189.99	A113-8704	16X	4.3	\$1,359.99
MMX Pentium 200MHz	A113-8600.1	8X	1.3	\$1,374.99	A113-8604	16X	4.3	\$1,544.99

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Processor	BUS	Slots	EDO RAM Support	SIMM Sockets	DIMM Sockets	Pipeline Cache	Motherboard Only Item #	Price Each	Motherboard And Case Item #	Kit Price
Pentium 133	PCI	4PC/4 ISA	Yes	2	2	512K	A113-8134.1	\$289.99	A113-8133.1	\$369.99
Pentium MMX 166	PCI	4PC/4 ISA	Yes	2	2	512K	A113-8167.2	\$299.99	A113-8166.2	\$389.99
Pentium MMX 200	PCI	4PC/4 ISA	Yes	2	2	512K	A113-8173.2	\$279.99	A113-8172.2	\$349.99
6x86 PR120+	PCI	4PC/3 ISA	Yes	4	None	256K	A113-8621.1	\$219.99	A113-8620.1	\$289.99
6x86 PR150+	PCI	4PC/4 ISA	Yes	2	2	512K	A113-8651.1	\$259.99	A113-8650.1	\$329.99
6x86 PR166+	PCI	4PC/4 ISA	Yes	2	2	512K	A113-8667.1	\$289.99	A113-8666.1	\$359.99
6x86 PR200+	PCI	4PC/4 ISA	Yes	2	2	512K	A113-8671.1	\$349.99	A113-8670.1	\$419.99

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Item	Description	Size	Max. Res.	Dot Pitch	View	Price
T92-1000	technidea 1440G	14"	1024x768	.28mm	13.5"	\$179.99
K26-1000	KDS VS-4	14"	1024x768	.28mm	13.2"	\$199.99
T92-1004	technidea 1564HS	15"	1280x1024	.28mm	13.7"	\$269.99
R41-1010	Reliase RES35	15"	1280x1024	.28mm	13.7"	\$249.99
K26-1002	KDS VSx-7 w/ Speakers	15"	1280x1024	.28mm	13.9"	\$289.99
S08-1508	Sony 100x8	15"	1280x1024	.25mm	13.9"	\$369.99
U19-1000	Utopia EV350	15"	1280x1024	.28mm	13.9"	\$269.99
R41-1012	Reliase RE760	17"	1280x1024	.28mm	16.0"	\$449.99
U19-1002	Utopia EV400	17"	1280x1024	.28mm	15.8"	\$449.99
K26-1004	KDS VSx-7 w/ Speakers	17"	1280x1024	.28mm	15.8"	\$499.99
S08-1506	Sony 200x8	17"	1280x1024	.25mm	15.9"	\$679.99
T92-1010	technidea TCM-1764S	17"	1280x1024	.28mm	15.7"	\$469.99

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Item	Processor	RAM/Exp. To	HD	CD	Screen	Price
A113-5010.2	Cyrix 6x86 PR166+	16MB EDO/80MB	1.3GB	10X	12.1" Dual Scan	\$1,889.99
A113-5020.2	Cyrix 6x86 PR166+	16MB EDO/80MB	1.9GB	10X	12.1" Active Matrix	\$2,499.99
A113-5030.2	Pentium 166MMX	16MB EDO/80MB	1.9GB	10X	12.1" Active Matrix	\$2,749.99

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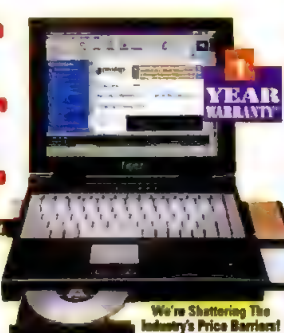
A113-5010.2

6x86 PR166+ \$2499⁹⁹

A113-5020.2

Pentium 166MMX \$2749⁹⁹

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A113-5020.2	Cyrix 6x86 PR166+	16MB EDO/80MB	1.9GB	10X	12.1" Active Matrix	\$2,499.99
A113-5030.2	Pentium 166MMX	16MB EDO/80MB	1.9GB	10X	12.1" Active Matrix	\$2,749.99

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A113-5020.2	Cyrix 6x86 PR166+	16MB EDO/80MB	1.9GB	10X	12.1" Active Matrix	\$2,499.99
A113-5030.2	Pentium 166MMX	16MB EDO/80MB	1.9GB	10X	12.1" Active Matrix	\$2,749.99

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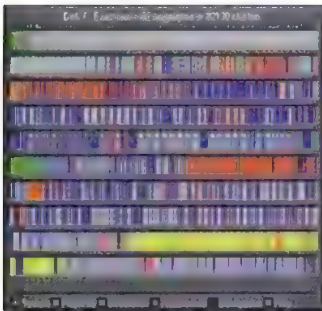
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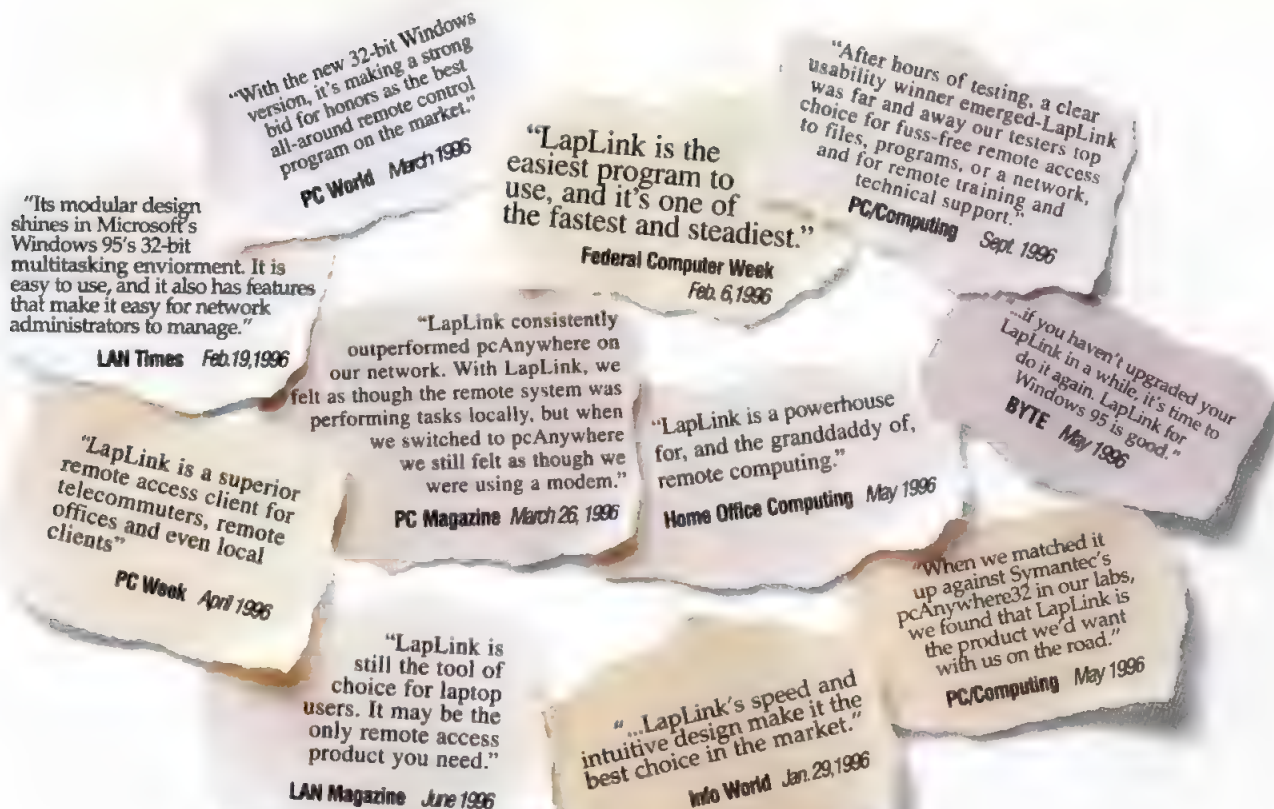
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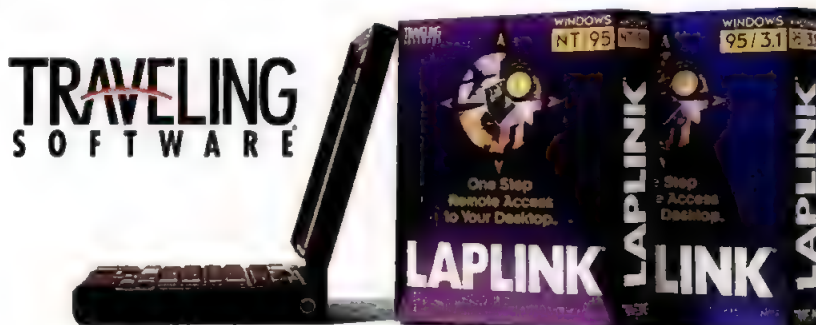
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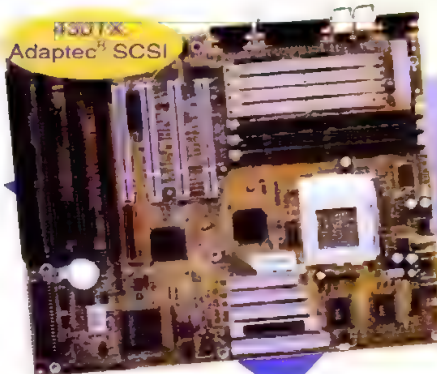
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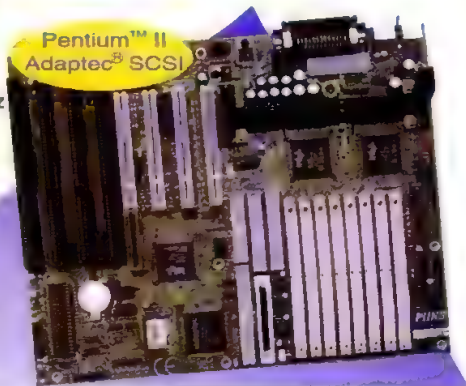
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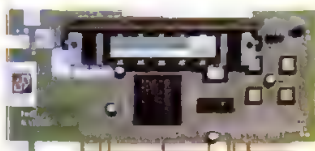


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Research has its rewards. For us, they've taken the form of one public recognition after another. In 1993 we pioneered a DRAM-based PCI bus VGA graphics board that won a Byte Magazine Award. The next year our PCI graphics accelerator card got the Best Product Award at CeBIT. And in 1995 it was Best Product again at the Computex Taipei show for our sound and 2D/3D VGA-compatible graphics-video accelerator. More is bound to come, too, with the big boost provided by our experts in mainboards, graphics video and telecommunication. We've been at work for over 10 years, but all the time it'll take you is a few minutes to fire off a fax or e-mail. What'll you get in return? To start with, all the facts about our easy-to-install Teleye videophone and the other multimedia marvels that may soon be our next prize-winners!



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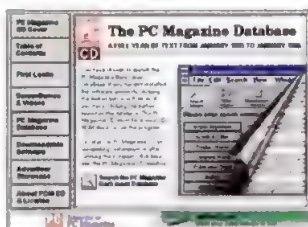
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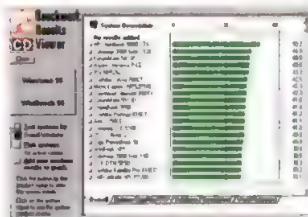
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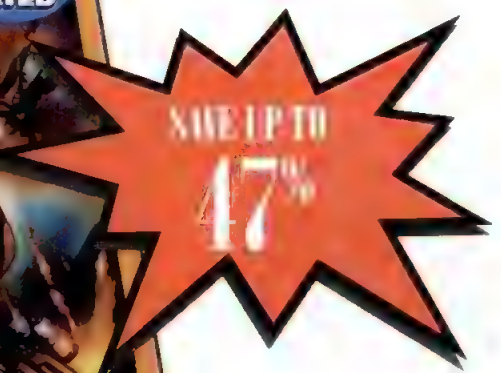
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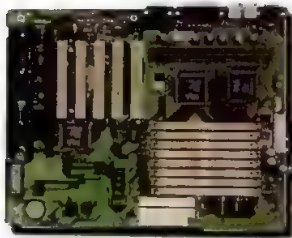
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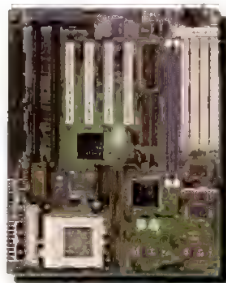
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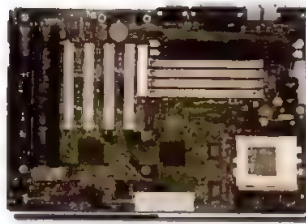
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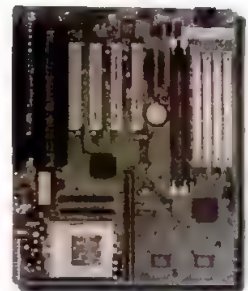
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Doesn't the perfect PC deserve the perfect removable storage solution?



May 6, 1997
EZFlyer 230

PC Magazine thinks so.

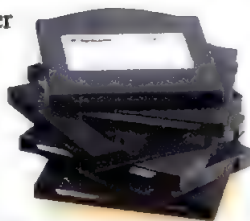


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**Small, high-quality
files make low-cost
video a powerful way
to communicate.**

The whole world seems to be networked. With the Internet, it's just as easy to share ideas with a friend in Australia as it is with a colleague on the second floor. But push technology combined with global access at the speed of light do offer an unfortunate side effect—information overload. So how do you break through the clutter and noise to make your communication heard?



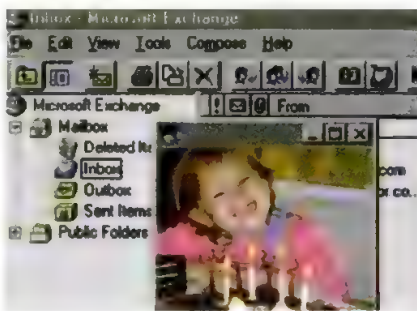
Today, more and more people are turning to video. Video tapes, video conferencing, and video on Websites. However, the problem with most digital video (the kind you get on your PC) is that the files, which range from three to seven Megabytes for a small video clip, are too big. Too big for a floppy disk, but too small for a Zip disk (100MB) or

CD-ROM (660MB). They take the better part of 20 minutes to download with a 28.8 Kbps modem, and the quality is not good enough to put back on video tape and show on a TV.

An easy video solution

Today, there's a new solution that makes video communication fast and easy. With the Alaris QuickVideo™ Transport, users can quickly and easily add video capabilities to their computer. QuickVideo Transport plugs into the parallel port, so there's no opening the computer to add a card. It even comes standard with video editing, image editing, morphing, video conferencing, and video e-mail software. And it works with any video source, from your camcorder to your VCR, laser disc, or DVD player.

To compress the video files, QuickVideo Transport comes with a unique software application called Videogram™ Creator. Videogram Creator takes any standard



.AVI (video), .BMP (bitmap image), or .WAV (audio) file, and compresses the files down to the point where a minute of synchronized audio and video will fit on a floppy disk including the Player.

Suddenly video e-mail (or Videograms as Alaris calls them) are viable communication tools. With a Videogram, sales representatives and consultants can get valuable "face time" without leaving their desks or interrupting their clients. Mom and dad can even e-mail home movies to grandma and grandpa, so they can watch

their grandchildren grow up despite living halfway across the country or halfway around the world. It offers all the benefits of voice mail and e-mail, plus the visual impact of seeing someone in person. You could say that Videograms offer a touch of humanity in a world dominated by faceless communication.

Perfect for home or office or both

Videograms allow you to stay in touch in person, without actually being there. In many cases, it's faster to create a 45-second Videogram than it is to write a note. And nothing conveys the immediacy and excitement of a moment as well as video. So the whole extended family can enjoy little Taylor's first steps, or Katie blowing out the four candles on her birthday cake.

With a Videogram, telecommuters can make sure nobody forgets about them, despite their remote location. You can stay in front of your boss without actually being there, and still get some of the plum

Video production firm saves time, cuts costs with Videograms.

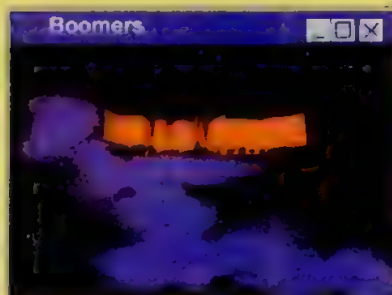
INET Multimedia develops content—everything from traditional TV commercials and product demo videos to CD-ROM animations and Web sites—for a variety of clients in the traffic-clogged Houston-metro area. With Videograms and a Pentium 133 system, INET is finding an efficient, easy-to-use timesaver. "We used to spend a good part of our work week stuck in traffic, heading to clients to get feedback on projects," said Robert Jacobs, director of video production at INET. "Now, we just e-mail a Videogram for rough off-line approvals. It saves us a tremendous amount of downtime and courier costs," he added.

Since INET downloads video direct from a betacam deck to an AVI file, the Videograms it produces are of exceptionally high quality. "The Videograms give

our clients a very good idea of what the finished product will look like, even when we bump up the screen size beyond 320 x 240 pixels. We use them to make interim edits and revisions, and now only have to show up in person when it's time to sign off on the final cut," noted Jacobs.

Memorable marketing with Videograms.

Leave it to multimedia experts to figure out innovative ways to use Videograms to connect with their customers. At a recent trade show, instead of hauling around company brochures with business cards, INET came armed with promotional Videograms on floppies. "It sure got their attention. They could pop in the floppy, click on the Videogram icon, and instantly see what we're all about," said Jacobs. "People pick up all sorts of literature at trade shows and then trash it in the hotel room. Our Videogram made it back to their offices."



With Videograms, INET clients can preview work-in-progress with ease and convenience.





Save time with smaller files.

The smaller the file, the quicker the upload (and download). Here are some tips on creating files that won't keep you—or the recipients of your Videograms—waiting long:

- Less motion makes for smaller files; to obtain more static images use a tripod with the camera
- A clear audio track provides better sound and creates a smaller file; for a clean track use a separate microphone
- Zooms, fades, dissolves, and other transitions increase file size
- Animations eat less bytes than video
- A still image with voice over can often communicate as much information as a full-motion video; this technique yields a very small Videogram file

assignments. Anyone running a small or home office can make the most of the technology by staying in front of customers, clients, colleagues, and vendors—motivating, cajoling, and collaborating.

Inside larger companies, Videograms allow training departments to share video clips via the intranet. Webmasters can put TV commercials and product launches on the corporate Website, and marketing departments can create presentations that incorporate slides and video in a single Videogram.

Easy Playback

Perhaps the best part is that the recipient of a Videogram needs nothing to play it back—except speakers and sound capability. The Videogram Player is built into the Videogram itself. A Videogram will run on any 486DX2/66 or Pentium PC running Windows 3.1x, Windows 95, or Windows NT. Videograms can also be developed to stream over the Internet. In this case, recipients will need to download the 400KB, 32-bit Videogram Player from the Alaris Website at www.alaris.com—it's free.

Now playing at a PC near you.

Movieweb, a virtual Hollywood on the World Wide Web (<http://movieweb.com>), provides Netizens with everything they could possibly want to know about the movies: film reviews, publicity shots, celebrity lore, links to the home pages of studios and stars, and trailers of selected new releases. When Movieweb first started, the service used QuickTime and Video for Windows for posting trailers to its site. Now, with Videograms "We get the same or better video quality, more fps (frames per second), and a much smaller file size," said Dave Riess, president of the Los Angeles company. "That saves us a lot of bandwidth and storage," he added.

The small, self-playing Videogram files make it fast and easy for Movieweb visitors to download and view trailers. "The capture and conversion are quite good," Riess noted. "The quality of the downloaded video files is excellent, especially when viewed at 160 x 120 pixels," he concluded.



Self-playing Videograms give Movieweb visitors instant access to Hollywood's latest releases.

Capture Full-Motion Video Without Opening Your PC



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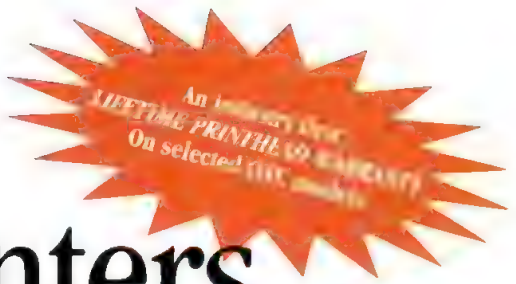


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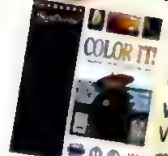


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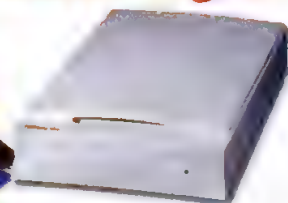
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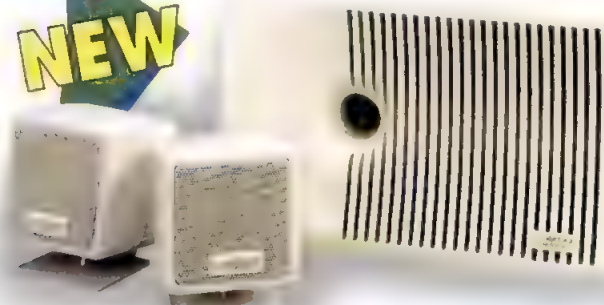
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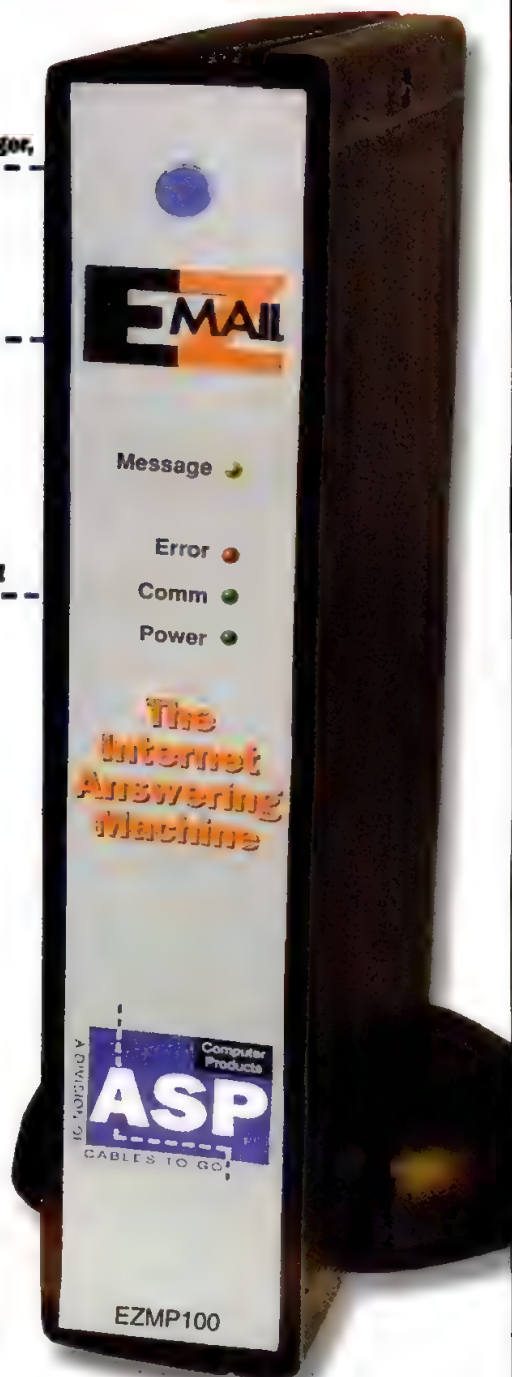
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User-to-User

BY NEIL J. RUBENKING

The Long and Short of .ZIP files

I recently downloaded some MIDI files from the Internet in .ZIP format and ran into a problem, because most of the unzipped files had long filenames. I run Windows for Workgroups 3.11, which truncates filenames after the first eight characters. This approach would not be a problem, except that any embedded spaces remain a part of the name. Since DOS and Windows 3.x do not allow spaces in a filename, the files can't be played, renamed, moved, or deleted.

You can use the DOS DELTREE command to remove the files, but it will delete everything else in the parent directory as well. Had I downloaded the files to the root directory, I would have had to move all the other files and directories to another drive or partition before using DELTREE. I have two suggestions as a result of my experience:

If you run Windows 95 and use long filenames for files that will be zipped for distribution, you should insert a hyphen or underscore instead of a space, to be sure the first eight characters are filled.

If you run Windows 3.x, always decompress any .ZIP files into a subdirectory so it can be easily removed with DELTREE, should the filenames contain spaces.

BILL LAHR
Compton, California

PC MAGAZINE: Older versions of DOS are curiously ambivalent about spaces in filenames. Spaces are not forbidden, as are such characters as the semicolon and square brackets. But if a file has a space in its name, most DOS commands simply don't know how to interpret it. Why? Because the space is a delimiter—it separates the elements of a command line. A command like this:

```
TYPE FOO BAR.TXT
```

will be interpreted as a request to display the nonexistent file FOO, using the invalid command line switch BAR.TXT.

But if you do encounter a file whose name contains a space, you don't have to nuke its entire directory using DELTREE! Instead, you can easily rename the file to eliminate the space. First, enter the DIR command followed by the name of the file, replacing the space with a question mark (a DOS wildcard

meaning any character):

```
DIR FOO?BAR.TXT
```

If DIR reports more than one matching file, move all of them except the space-infested file to another directory. Now you can rename the file, again using a question mark in place of the space, and substituting a legal character in the new filename:

```
REN FOO?BAR.TXT  
FOOXBAR.TXT
```

One further note for those using 32-bit Windows: A number of .ZIP file utility programs, such as WinZIP, correctly handle long filenames.

These utilities provide the additional benefit of a GUI-style interface for manipulating the contents of .ZIP files. If you make use of .ZIP files in a 32-bit environment, you'll want to search your favorite shareware BBS or Web site for one of these modern .ZIP file utilities.

Supercharge the Windows Send To Menu

I use the simple batch file shown in Figure 1 to simplify sending files to any program on my Start menu in Windows 95. The batch file copies the contents of my Start menu | Pro-

```
deltree /y c:\windows\sendto\programs  
md c:\windows\sendto\Programs  
xcopy /s /q c:\windows\startm-1\programs c:\windows\sendto\programs
```

FIGURE 1: Run this batch file to copy your Start menu programs into the Send To menu.

grams menu to my Send To menu. I've set it up so that System Agent runs the batch file at regular intervals to keep the Send To menu updated with any changes I've made to my Start menu. I also set the properties of my batch file both to run minimized and to terminate on exit, so it's a convenient, worry-free, background operation.

JAMES S. ADAMS
via the Internet

PC MAGAZINE: Windows lets you associate each file type with only one application, but you may often want to open the same file

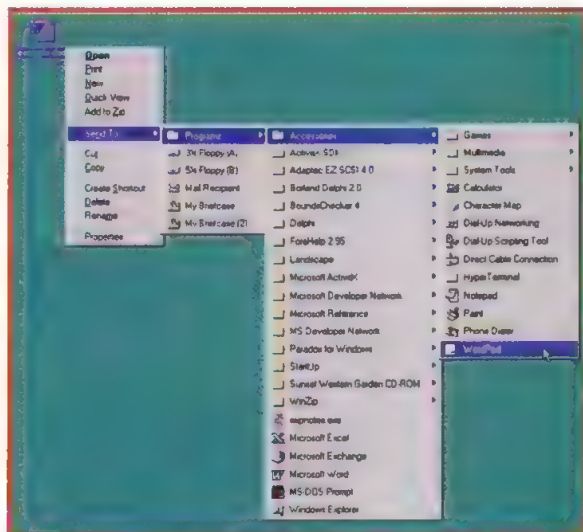


FIGURE 2: When the Programs menu is copied to the Send To menu, you can open any file with any compatible application.

with more than one application. For example, you may load a Microsoft Word .DOC file into WordPad when you just want a quick look, because WordPad loads faster, or you may use a number of different programs to edit .BMP files. By copying your entire Start menu to the Send To menu, you can easily open any file with any compatible application under Windows 95 or Windows NT 4.0, as Figure 2 shows.

If your Windows folder is not C:\windows, you'll have to edit the batch file before using it. Also, if the User Profiles feature is enabled on your system, you'll need to work in

your own profile folder rather than in the Windows folder. For example, instead of C:\windows\sendto, you might refer to C:\windows\profiles\Neil\sendto.

Unless you're in the habit of changing your Start menu several times a day, running the batch file using System Agent is probably overkill. All you have to do is launch it each time you make a change to the Start menu. If that seems too tedious and you would prefer an automated approach, just put System Agent in your StartUp group and the Send To menu will be updated each time you start Windows.



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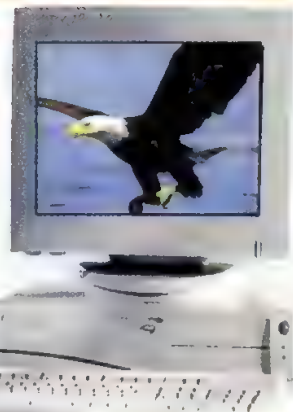
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Compaq Deskpro 2000, 4000 and 6000 Series set new standards for cost of ownership and serviceability in desktop personal computing for small, medium and large businesses. Compaq adds Intelligent Manageability to its entry level Deskpro 2000 line and includes new desktop manageability features in the Deskpro 4000 and Deskpro 6000 models—Inventory, Fault and Security Management—making Deskpro easier to inventory, troubleshoot, and protect. This second generation of Intelligent Manageability also offers a unique Smart Cover Sensor on the hood of the PC that alerts users and systems administrators of unauthorized access. All models include a 3-year parts, first year labor and on-site repair warranty.

Monitor sold separately



Deskpro 2000 Series

The features you want, smartly priced

✓ 256KB Level 2 cache ✓ CD models include internal 8X IDE CD-ROM drive ✓ SMART EIDE hard drives ✓ 1MB EDO DRAM std., 2MB max. ✓ Model 6200 includes Matrox Millennium graphics controller with 2MB WRAM ✓ Expansion slots: two

PCI; one shared PCI/ISA; two ISA
✓ Dual-install operating system (Pentium models): MS-DOS/Windows* V3.1 or Windows 95
✓ Operating system (Pentium Pro models): Windows NT Workstation



Monitor sold separately

price
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Compaq Deskpro 2000 series						
Desktop	CPU	RAM	Hard drive	Price	CDW	
5133/1200	133MHz Pentium	16MB	1.2GB	\$1089.00	72608	
5133/2500	133MHz Pentium	16MB	2.5GB	\$1169.00	72613	
5166/1200	166MHz Pentium	16MB	1.2GB	\$1209.00	72610	
5166/2500	166MHz Pentium	16MB	2.5GB	\$1289.00	72614	
5200/2500	200MHz Pentium	32MB	2.5GB	\$1709.00	72755	
6180/1200/CD	180MHz Pentium Pro	16MB	1.2GB	\$1739.00	72756	
6180/2500/CD	180MHz Pentium Pro	32MB	2.5GB	\$1929.00	84263	
6200/2500/CD	200MHz Pentium Pro	16MB	2.5GB	\$2209.00	72762	
Mini-tower	CPU	RAM	Hard drive	Price	CDW	
5133/2500/CD	133MHz Pentium	16MB	2.5GB	\$1309.00	72763	
5166/2500/CD	166MHz Pentium	32MB	2.5GB	\$1549.00	72764	
6200/2500/CD	200MHz Pentium Pro	32MB	2.5GB	\$2329.00	72765	

price
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Compaq Deskpro 4000 series

Desktop	CPU	RAM	Hard drive	Price	CDW
5133/1620	133MHz Pentium	16MB	1.62GB	\$1269.00	72768
5166/1620	166MHz Pentium	16MB	1.62GB	\$1399.00	72770
5166/2500/LS	166MHz Pentium	16MB	2.5GB	\$1479.00	72771
5200/2500/LS	200MHz Pentium	32MB	2.5GB	\$1899.00	84264
6180/1620/CDS	180MHz Pentium Pro	32MB	1.62GB	\$2039.00	72778
6180/2500/CDS/LS	180MHz Pentium Pro	32MB	2.5GB	\$2109.00	84265
6200/2500/LS/CDS	200MHz Pentium Pro	32MB	2.5GB	\$2419.00	72779
6233X/2500/CDS	233MHz Pentium II	32MB	2.5GB	\$2619.00	88475
Mini-tower	CPU	RAM	Hard drive	Price	CDW
5133/1620/LS	133MHz Pentium	32MB	1.62GB	\$1399.00	72780
5166/2500/CDS	166MHz Pentium	32MB	2.5GB	\$1789.00	72781

Deskpro 4000 Series

Network-ready, optimal performance

✓ 256KB Level 2 cache, 512KB Level 2 cache (Pentium II)
✓ SMART EIDE hard drives ✓ LS models include internal LS-120 drive ✓ CDS models include: internal 8X IDE CD-ROM drive; Enhanced Business Pro Audio; Windows Sound System V2.0 ✓ 2MB EDO DRAM standard
✓ Expansion slots: two PCI; one shared PCI/ISA; two ISA
✓ Expansion slots (Pentium Pro): three PCI; one shared PCI/ISA; one ISA
✓ Expansion slots (mini-towers): three PCI; four ISA
✓ Integrated 10BASE-T Ethernet controller
✓ Dual-install operating system (Pentium models): MS-DOS/Windows* V3.1 or Windows 95
✓ Operating system (Pentium Pro and Pentium II models): Windows NT Workstation

price
drop!

Deskpro 6000 Series

Ultimate performance and innovation

✓ 512KB Level 2 cache (Pentium and Pentium II); 256KB L2 cache (Pentium Pro) ✓ Ultra SCSI hard drives ✓ CDS models include: 8X IDE CD-ROM drive; Enhanced Business Pro Audio; Windows Sound System V2.0 ✓ 2MB EDO DRAM standard ✓ Matrox Millennium graphics controller ✓ Expansion slots: three PCI; one shared PCI/ISA; one ISA
✓ Expansion slots (mini-towers): four PCI; three ISA
✓ Integrated 10BASE-T Ethernet controller ✓ Operating system: Windows NT Workstation

Compaq Deskpro 6000 series

Desktop	CPU	RAM	Hard drive	CD-ROM	Price	CDW
5166/1080/CDS	166MHz Pentium	16MB	1.08GB	8X	\$1589.00	72773
5166/1080/CDS	166MHz Pentium	32MB	1.08GB	8X	\$1709.00	72774
5200/2150/PDS	200MHz Pentium	32MB	2.15GB	PD-CD Drive	\$2679.00	84266
6180/2150/CDS	180MHz Pentium Pro	32MB	2.15GB	8X	\$2509.00	72785
6200/2150/CDS	200MHz Pentium Pro	32MB	2.15GB	8X	\$2819.00	72786
6200/4200/PDS	200MHz Pentium Pro	32MB	4.2GB	PD-CD Drive	\$3219.00	84268
6233X/2150/PDS	233MHz Pentium II	32MB	2.15GB	PD-CD Drive	CALL!	88473
6266X/4200/CDS	266MHz Pentium II	32MB	4.2GB	8X	\$3529.00	88474
Mini-tower	CPU	RAM	Hard drive	CD-ROM	Price	CDW
5166/2150/CDS	166MHz Pentium	32MB	2.15GB	8X	\$2019.00	72775
5166X/2150/PDS	166MHz Pentium MMX	32MB	2.15GB	PD-CD Drive	\$2479.00	84269
5200X/4200/PDS	200MHz Pentium MMX	32MB	4.2GB	PD-CD Drive	\$3139.00	84270
6200/4200/PDS	200MHz Pentium Pro	64MB	4.2GB	PD-CD Drive	\$3509.00	84271

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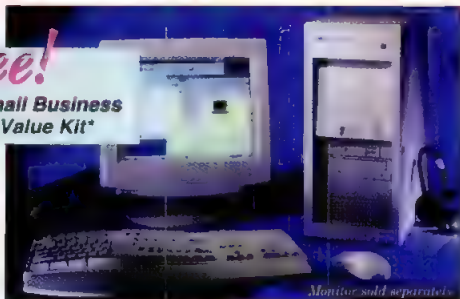
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Hewlett Packard Vectra 500 Series PCs

Desktop	CPU	RAM	Hard drive	CD-ROM	Price	CDW
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520CD	133MHz Pentium	16MB	1.2GB	8X	\$1169.42	84435
520MCx	133MHz Pentium	16MB	1.2GB	8X	\$1329.13	84437
520	166MHz Pentium	16MB	1.2GB	—	\$1157.70	84434
520MCx	166MHz Pentium	16MB	1.6GB	16X Max	\$1558.06	84438
Mini-tower	CPU	RAM	Hard drive	CD-ROM	Price	CDW
525MCx	133MHz Pentium	16MB	1.6GB	16X Max	\$1478.60	84442
525CD	166MHz Pentium	16MB	1.6GB	16X Max	\$1405.84	84449
525CDT	166MHz Pentium MMX	16MB	2.5GB	16X Max	\$1414.72	84450
525MCx	166MHz Pentium MMX	24MB	2.5GB	16X Max	\$1439.38	84443
525CD	200MHz Pentium MMX	24MB	2.5GB	16X Max	\$2068.63	84444
525MCx	200MHz Pentium MMX	32MB	3.8GB	16X Max	\$2459.78	84445

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Toshiba Equium systems

Desktop	CPU	RAM	Hard drive	CD-ROM	Price	CDW
5160D	166MHz Pentium MMX	32MB	2.07GB	12X	\$1769.12	84248
5200D	200MHz Pentium MMX	32MB	2.38GB	12X	\$1967.76	84249
6200D	200MHz Pentium Pro	32MB	2.95GB	12X	\$2359.74	84251
Mini-tower	CPU	RAM	Hard drive	CD-ROM	Price	CDW
6200M	200MHz Pentium Pro	32MB	4.24GB	12X	\$3248.21	84252



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IBM PC 300GL Series

CPU	RAM	Hard drive	CD-ROM	Price	CDW
133MHz Pentium	16MB	1.2GB	—	\$1119.22	85191
166MHz Pentium	16MB	1.2GB	—	\$1257.06	85188
166MHz Pentium	16MB	2.5GB	—	\$1339.76	85190
166MHz Pentium	16MB	2.5GB	16X	\$1576.84	85189
166MHz Pentium MMX*	32MB	2.5GB	—	\$1699.48	85405

IBM PC 300XL Series

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IBM PC 300XL Series

CPU	RAM	Hard drive	CD-ROM	Price	CDW
233MHz Pentium II	32MB	2.5GB	16X Max	\$2639.89	86313
233MHz Pentium II	32MB	2.5GB	—	\$2366.39	86314*
266MHz Pentium II	32MB	4.2GB	16X Max	\$3049.52	86315
266MHz Pentium II	32MB	4.3GB**	16X Max	\$3379.75	86316

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- ✓ 120MHz Intel Pentium® processor
- ✓ 16MB EDO RAM standard, 48MB maximum
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Tecra 510CDT

- ✓ 133MHz Intel Pentium® processor
- ✓ 16MB EDO RAM standard, 144MB maximum
- ✓ 2.1GB hard drive
- ✓ 10X CD-ROM drive
- ✓ 12.1" active-matrix SVGA color display
- ✓ 28.8K bps data/fax modem

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CDW 77241



Portege 660CDT

- ✓ 150MHz Intel Pentium® processor
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- ✓ 10X CD-ROM drive
- ✓ 11.3" active matrix SVGA color display
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CDW 70244

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- ◆ Integrated 28.8K bps (V.34) modem
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Tecra 740CDT

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- ◆ Noteworthy Video Conferencing kit includes color video camera, CardBus Capture Card and Intel ProShare software

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1520DM	133MHz Pentium	16MB	1GB	10X	11.3" dual scan	\$2199.00	87072
1550DMT	133MHz Pentium	16MB	1.4GB	10X	12.1" active matrix	\$3599.00	87070



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*Rebates may be combined; call for details. Offer ends 7/31/97.

IBM ThinkPad 380 Series

Model	CPU	RAM	Hard drive	CD-ROM	Color display	Price	CDW
380	150MHz Pentium	16MB	1.08GB	Optional	12.1" dual scan	\$2169.96	86302
380D	150MHz Pentium	16MB	1.35GB	8X	12.1" dual scan	\$2468.38	86304
380D	150MHz Pentium MMX	16MB	2.1GB	8X	12.1" active matrix	\$3846.33	86305

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- 1.35GB hard drive

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- 150MHz Pentium MMX processor
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\$4399.00 CDW 83606

- 166MHz Pentium MMX processor
- 2.1GB hard drive

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- ▲ Internal 33.6K bps data/fax/voice modem
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- ▲ Windows NT Workstation V4.0 (6050NT)
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COMPAQ

Armada 1120	8MB	\$88.87	71679	16MB	\$125.82	71680
Armada 4110 series, 4120 series, 4130 series	8MB	\$93.38	74015	16MB	\$149.31	74917
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970-PentiumP5-75, 90, 100, 120, 135, 150, 166, Family PC, P5-100, 120, 133, 150, 166 BestBuy	8MB	\$84.77	57571	16MB	\$188.82	57572
	32MB	\$334.57	57573	64MB	\$489.91	57575

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MX series, 1337, 150T, 160T	8MB	\$88.51	85193	16MB	\$188.87	85195
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ThinkPad 360, X, XD series, 690, 700 E, ED, EL, ELD	8MB	\$89.15	60680	16MB	\$129.92	60704
	32MB	\$289.90	71913			

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	4MB	\$88.77	42715	8MB	\$97.54	42716
	16MB	\$154.12	42717			

ThinkPad 760, 760 C series, P

	8MB	\$148.31	35181	16MB	\$194.47	35182
	32MB	\$389.65	43510			

NEC

Verano 6000, 6030 series, 6050 series	8MB	\$94.48	71586	16MB	\$188.10	71589
	32MB	\$278.41	71584			

Verano 2000 series

	8MB	\$88.47	44184	16MB	\$129.88	44186
	4MB	\$39.48	78393	8MB	\$88.51	78394
	16MB	\$127.90	78396			

Verano 2000

	8MB	\$104.30	85753	16MB	\$188.88	85754
	32MB	\$349.33	85755	64MB	\$789.84	85756

Verano 4000 series, E, V, M, P

	4MB	\$81.26	30555	8MB	\$87.82	30557
	12MB	\$128.81	43231	16MB	\$148.31	31342
	20MB	\$186.19	43040	32MB	\$278.89	43041

Verano 6200MX, NT

	16MB	\$147.50	85196	32MB	\$278.41	85192
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Excursion 510, 515	8MB	\$79.30	72130	16MB	\$129.31	72134
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Trevallite 6000	16MB	\$168.82	73985			

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Equium 81600, 82000, 82000	8MB	\$88.80	67226	16MB	\$118.84	67227
Infra 7130, 7160, 7200	8MB	\$88.19	76190	16MB	\$158.82	76191
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Easy-to-use, value-packed printing for small workgroups

- ◆ Resolution: 600 x 600 dpi with Resolution Enhancement technology (REt) and microfine toner designed for 600 dpi printing ◆ Print speed: 12 ppm ◆ RAM: 1MB standard with Memory Enhancement technology (MEt), 66MB maximum ◆ Printer language: HP PCL 6 ◆ Paper handling: letter, legal, A4, A5, executive, copier, bond, special application, recycled paper, overhead transparencies and labels ◆ Software: HP LaserJet Publishing Internet Kit CD-ROM: Microsoft Internet Explorer, Bookmarks with small business orientation, 60 days free Microsoft Network, 60 day trial version of Microsoft Publisher and a \$20 rebate coupon toward Publisher ◆ 1-year warranty ◆ HP C3082A

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HP DeskJet 820Cse printer

Professional Series

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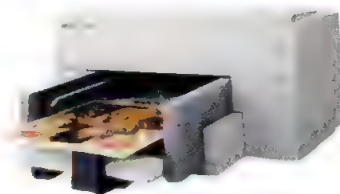


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Versatile, photo-quality printer for fun family projects

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HP LaserJet 6Pse printer

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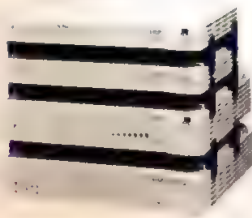
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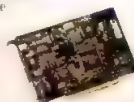


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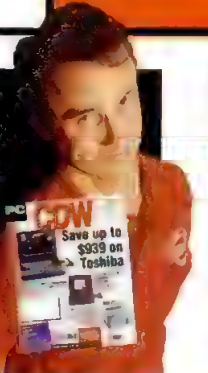
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HARDWARE

Game Over?

My son inadvertently swapped joysticks without powering down the PC. Now any joystick on any card with a game port will not stabilize. When I test a joystick under Windows 95's Joystick utility in the Control Panel, there is always a + value on both axes, and it is not possible to stop the cursor. Am I going to have to replace my motherboard, or is there possibly a chip or other component that may have been damaged and can be replaced?

LANNY TONEY
via the Internet

PC MAGAZINE: It is unlikely that any damage went beyond the expansion card that had the game port, and there is some question as to whether the joystick swap would have caused any damage in the first place. Possibly this is simply a configuration or a driver problem.

One possible explanation for the problem is that you have two conflicting ports. If the original is integrated on your computer's motherboard, be sure to disable it before you attempt to install an expansion card with its own game port. Check the Device Manager display in the Control Panel's System applet to make sure that the Gameport Joystick entry (under Sound, Video, and Game Controllers) is working correctly, without any conflicts.

If all this appears to be correct, then remove the driver for the joystick and allow Windows 95's Add New Hardware auto-detect feature to find the port and reconfigure the driver settings. If this still doesn't work, try restoring the port drivers from the original Windows 95 disks, as they may have become corrupted.

The reason it is unlikely that the game port or joystick were damaged lies in how they work. A game port works by measuring the resistance of the joystick's two axes and converting these measurements into numeric data that can be passed along the computer's data bus. A game port can also sense when the joystick buttons are pressed, which closes a circuit.

If you have a voltmeter, you can test the signals from the game port yourself. Put the voltmeter in DC mode, with a range that will show 5 volts (choose the next-highest range, such as 15 volts). With the computer turned on, the following pin combinations on the computer's game port should all indicate +5 volts DC.

Here is a table of the port's connections:

Pin	Signal
1	+5 volts DC
2	Joystick A, button 1
3	Joystick A, x-axis
4	Ground
5	Ground
6	Joystick A, y-axis
7	Joystick A, button 2
8	+5 volts DC
9	+5 volts DC
10	Joystick B, button 1
11	Joystick B, x-axis
12	Ground
13	Joystick B, y-axis
14	Joystick B, button 2
15	+5 volts DC

You can also use an ohmmeter to check that the ground signals are properly connected. An ohmmeter measures resistance, and there should not be any resistance between the ground pins on the game port (pins 4, 5, and 12) and the chassis of the computer. Put the ohmmeter on its lowest scale and touch the two leads of the ohmmeter together; they should produce a readout of 0. Then, with the computer power turned off but with the power cord still plugged in, touch one lead to the outside of the power supply of the computer and the other lead to pins 4, 5, and 12. You should get a reading near 0. You can also use the ohmmeter to make sure that the joystick buttons are working correctly and that the joystick's axes are producing variable resistance as you move the control.

While it is always prudent to plug and unplug components only when the computer is turned off, it is unlikely that changing joysticks would create a problem. And even if it did damage the game port, any damage to the computer itself would be conducted through the expansion card data bus, so other components and functions would be affected as well.

—Alfred Poor

OPERATING ENVIRONMENTS

What to Do with .CHK Files

I am currently running DOS 6.2 and Windows 3.1. I recently ran SCANDISK to check my hard disk. The program created six files with the .CHK extension. I then used the TYPE command to try to review the files but saw only gibberish. File Manager won't open these files, because it says there's no application associated

with the file. And Microsoft Word won't open them, either. Is there any way I can determine what is in these files? They are quite large, and if they are useless, I'd like to delete them.

JOHN R. SCHMITZ
via the Internet

PC MAGAZINE: Whether they're created by DOS's SCANDISK, Windows 95's SCANDISK, or the DOS CHKDSK program, .CHK files represent space on your disk that was marked as "in use" but didn't actually belong to any particular file. They're usually caused by incomplete file-writing operations, which in turn can be caused by a program or system crash.

The data in a .CHK file can represent any type of file, or it can be incomplete chunks of a file. Viewing .CHK files with TYPE isn't terribly useful, since the listing will fly past too fast and will stop if a byte with the value 26 (Ctrl-Z, or end-of-file) is reached. Instead, try loading the files into Windows Write. Write is surprisingly good at loading binary files, and you can scroll through the file to see if any text is present that might help identify the file. If you can determine the original file type, you can try renaming the .CHK file and open-

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PCTech Ask Our Advisors

ing it with the appropriate application. Even if the file is incomplete, you still may be able to copy text out of it.

Most of the time, however, .CHK files are useless, not worth the time you'd spend to evaluate them. Unless you've had a recent program or system crash and lost certain files, you can reasonably delete .CHK files. If you're unsure, examine each file as described above. If you can rename it to a particular file type and get the corresponding application to load it, excellent! If you can't, try to extract any text you can find within the file, and then delete the file. If no text is visible and you can't find a program that will open it, just delete the file. One way or another, after your examination there should be no .CHK files left on the disk.

In the future, you'll want to deal with .CHK files immediately, because you're more likely to be able to determine their origins by comparison with the work you've been doing recently.—Neil J. Rubenking

WORD PROCESSING

Default Directories in WinWord

A recent upgrade to Windows 95 and Word 7 has left me with a problem that I can't solve. Under Windows 3.1 and Word 6, I had three Word icons, one for each family member. By choosing the appropriate icon, each person could start Word with a different default directory for documents.

With Windows 3.1 and Word 6, this was easy to set up. In general, you can change a program's starting data directory in Windows 3.1 by selecting the icon, choosing File | Properties, and entering the directory you want to use in the Working Directory text box.

Word has its own setting for the default document directory, which you can specify by choosing Tools | Options and then File Locations, highlighting Documents, and choosing Modify. This setting will normally override the setting for the icon, but if you don't choose a Documents entry, Word will use the icon's Working Directory as the default data directory. You can set Word's default directory as blank either from within the program, using the Tools | Options command as already described, or by editing the WINWORD6.INI file to delete the DOC-PATH entry. Once you've set up Word, you can create as many icons as you

you change the .INI file, since Word 7 doesn't use one. Is there any way to regain this feature with Word 7?

JOHN MARKHAM
via PC Magazine Online

PC MAGAZINE: What Mr. Markham points out about Word 7 applies to Word 97 also. In either case, if you use the Tools | Options command to set the document path to a blank entry, Word will enter My Documents as the default directory. The settings for Word 7 and Word 97 are stored in the registry, but it doesn't help to set the registry entry for DOC-PATH to a blank either. Here again, Word will simply use My Documents as the default. There are, however, at least three ways to get the same results with Word 7—and Word 97.

In these programs, the simplest way to set up different default directories for each user is to use Windows 95's User Profiles in Windows 95 itself. To turn it on, choose Start | Settings | Control Panel. In the Control Panel, double-click on the Passwords icon or select it and then hit Enter, to open the Passwords Properties dialog box. Go to the User Profiles tab, choose Users Can Customize Their Preferences And Desktop Settings, and choose OK.

Once the feature is turned on, each time you start your system, Windows will ask you to log on with a name and a password. Each user can enter his or her own name and either enter a password or leave the entry blank. Users can set their own default directories for Word using Word's Tools | Options command, and Windows will automatically store different settings for each user name. To let Windows know which settings to use, simply log on with the appropriate name. If Windows is already running, choose Start | Shut Down, then select Close All Programs And Log On As A Different User.

A second choice for setting different default directories is to create a series of macros within Word, with each one specifying a directory. Attach each macro to a menu item, toolbar button, or keystroke combination so that each user can easily run it. This technique also has wider applicability, since anyone who uses more than one directory can use such a macro to switch directories. Unfortunately, I don't have room to show the macros here. I'll save that for another time if enough readers express an interest.

A third choice, finally, is to start Word

icon. If the shortcut is on the Windows 95 desktop, right-click on the shortcut or select it and hit Shift-F10. Then choose Properties, go to the Shortcut tab, move to the Start In text box, and enter the drive and path for the default data directory (or folder, if you prefer the Windows 95 terminology). If the shortcut is on the Start menu, choose Start | Menus | Taskbar, go to the Start Menu Programs tab, choose Advanced, and navigate your way to the shortcut you want to change. (Mouse users can right-click on the Start button, choose Explore, and navigate to the shortcut.) Once you've found the shortcut, right-click on it or select it and hit Shift-F10, choose Properties, and follow the same steps as for a shortcut on your desktop.

Of course, the whole point of Mr. Markham's letter is that setting the Start In directory generally won't work. You also have to trick Word into using the setting. A little experimentation showed that although you can't set the default directory as blank in Word 7 and Word 97, you'll get the same effect if you enter a directory that doesn't exist. (The one exception is an entry for My Documents, which Word insists on creating if it doesn't already exist.)

To make Word 7 or Word 97 use the directory defined in the shortcut, first create a blank directory using any name you like. Then use Word's Tools | Options command to set it as the default document directory. Next, delete the blank directory. If you give the Tools | Options command and look at the File Locations tab, you'll see that Word is still set to use the nonexistent directory for its default. When it doesn't find that directory, it will fall back to using the directory defined in the shortcut as the default.

Finally, it's worth explaining the details of how to make this trick work with Word 6 (for those who are still using that program). To set the Word 6 default directory, choose Tools | Options, go to the File Locations tab, highlight Documents, and choose Modify. Then, in the Location Of Documents text box, enter your choice for the default document directory, and choose OK. To let the icon's Working Directory control the default directory, make sure the Location Of Documents text box is blank before you choose OK.

Word stores this setting in the WINWORD6.INI file. If you prefer to edit the file directly, you can use any text-editing program, including Word. Just be careful not to make



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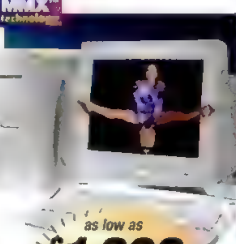
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before Word will read the new setting.

You'll find WINWORD6.INI in the Windows directory. If there is a DOC-PATH line in the file, it will take the form:

DOC-PATH=D:\PATH

where D:\PATH is the drive and path for the default directory. You can remove this line, or you can add a semicolon to the beginning of the line to tell Word to ignore it.

If you've moved to Windows 95 but are still using Word 6, you can use the same approach by setting the Start In directory for the shortcut, as already described for Word 7 and Word 97.—*M. David Stone*

DATABASES

Preventing Row Deletions in Access Subforms

I have a form and a subform in a Microsoft Access database, in which the tables have a one-to-many relationship with referential integrity enforced. Is there a way to prevent end users from deleting a record in the subform?

When I used to use dBASE, deleted rows were not actually deleted until the database was "packed." Until then they would just be "marked for deletion," and you could easily recall them. This was a nice feature, especially for undoing the actions of occasionally coniving users. But I haven't found anything thus far in Access that will prevent the user from deleting records. (With the security features, I have found ways of keeping them from deleting files but not records.)

JOE OLSON
Wichita, Kansas

PC MAGAZINE: Preventing deletions in a subform is actually easier than you might think. When a user presses the Del key (or selects

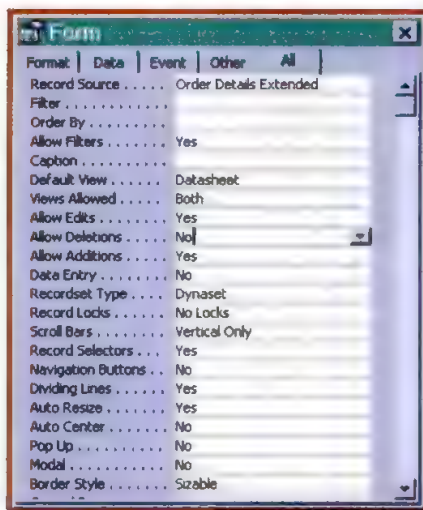


FIGURE 2: To prevent a user from deleting a row in a subform in Access 95 or 97, set the subform's Allow Deletions property to No.

the Edit menu and chooses Delete), Access calls the subform's Delete method and passes it a Cancel variable that you can set. To prevent the deletion you just set the cancel variable to True, as shown in the code example in Figure 1. I have also added code to sound a beep and place an appropriate message on the status bar.

To place this code in your subform's Delete event, you must open up your main form in Design mode and then double-click on the subform to open it, too. Next, select the Edit menu and choose Select Form, then select the View menu and choose Properties. This will open up the Properties window, whose title bar should say "Form"—to indicate that you are viewing the Form level properties and not the properties of some other object. Next, scroll down and click in the text box next to the On Delete property, then click on the ellipsis to bring up the Choose Builder dialog. Choose Select Code

Builder in the Choose Builder dialog and then choose OK.

At this point you have an editor window in which you can enter or modify the event code associated with the Delete event. Edit the text so that it matches the code shown in Figure 1. Then close your form and choose Yes when asked whether you want to save your changes. The next time you try to delete a row in the subform, you'll hear a beep and see the message we placed in the status bar. Any attempt to delete a row through the subform will be canceled.

In Access 95 and Access 97 it's even easier, thanks to the subform's Allow Deletions property, which tells Access whether record deletions are allowed. To prevent deletions, you set this property to No. First, open up your main form in Design mode and then double-click on the subform to open it, too. Next, select the Edit menu and choose Select Form, and then select the View menu and then Properties. The Properties window should say "Form." Scroll down and click in the text box next to the Allow Deletions property, then click on the arrow and choose No. (You can also double-click on the text box to toggle the value between Yes and No.) At this point the Properties window should look like Figure 2.

Now you can close your form and choose Yes when you're asked whether you want to save your changes. The next time that you try to delete a row in the subform, you'll hear a beep and see the message that we placed in the status bar. Any attempt to delete a row through the subform will be canceled.—*Sal Ricciardi*

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```
Sub Form_Delete (Cancel As Integer)
```

```
*****
' Beep to indicate that deletions are not allowed. Display an appropriate
' message on the status bar. Cancel any attempt to delete a row on this
' subform.
*****
```

```
DoCmd Beep
```

```
ReturnValue = SysCmd(SYSCMD_SETSTATUS, "Records can't be deleted with this
form.")
```

```
Cancel = True ' This cancels the Delete
```

```
End Sub
```

FIGURE 1: In Access 2, place this code in your subform's Delete event to prevent the user from deleting rows. If a user tries to do so, the code will sound a beep, display an appropriate message in the status bar, and cancel the deletion. In Access 95 and 97 this code is not necessary: You can simply change the subform's Allow Deletions property to No.

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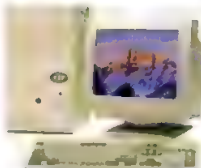
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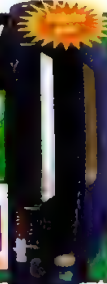
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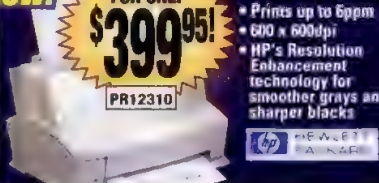
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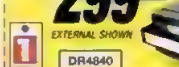
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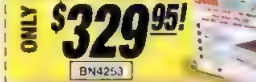
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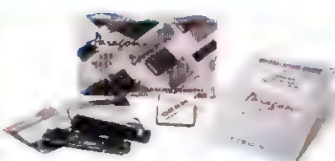
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- 16MB EDO RAM memory
- 12.1" Active Matrix display

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\$5599⁰⁰
 Price Break **-900⁰⁰**
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\$4449⁰⁰
 3-Year TAP Warranty \$99.97

Model	CPU	Screen	RAM/HD	CD	Price
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*Price after instant rebate and price break.



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Tecra 730XCDT

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- 11.3" Dual Scan Screen
- 6X CD-ROM Drive



Satellite Pro 420CDS

Standard Pro 420CDS
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Model	CPU	Screen	RAM/HD	CD	Price
420CDS	100MHz	11.3" Dual Scan	8/772MB	6X	\$1399*
430CDS	120MHz	11.3" Dual Scan	16MB/1.2GB	10X	1599
430CDT	120MHz	11.3" Active	16MB/1.2GB	10X	2259

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Tecra 500

- 120 MHz processors
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- 12.1" Active Matrix displays



Tecra 500CDT

Tecra 500CDT
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Model	CPU	Screen	RAM/HD	CD	Price
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560	100MHz	11.3" Dual Scan	8/810MB	Opt.	\$1599*
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*Price after price break.



Presario 1070
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Price Break -200.00
\$2499.00

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Model	CPU	Screen	RAM/HD	CD	Price
5250	120MHz	10.4" Active	16/810MB	Opt.	\$2729
5280	120MHz	11.3" Active	16MB/1.35GB	Opt.	3439
5300	133MHz	12.1" Active	16MB/1.35GB	Opt.	3859
5400	150MHz	12.1" Active	32MB/2.2GB	Opt.	4349

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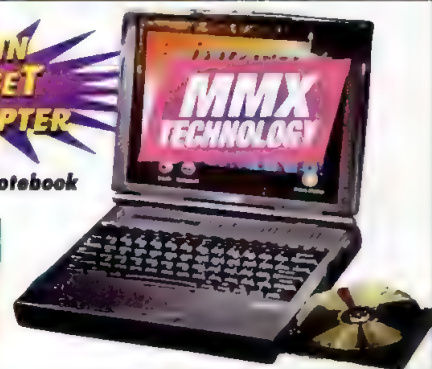
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531T	133MHz	11.3" Active	16MB/1.3GB	6X	2499
555Tx	150MHz MMX	12.1" Active	16MB/2.0GB	10X	3799*

* Includes 33.6 fax/modem

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C8E	166MHz MMX	32MB/3.2GB	16X	1899
S8C	166MHz MMX	32MB/3.2GB	16X	1899
C9E	200MHz MMX	32MB/3.2GB	16X	1999
S9C	200MHz MMX	32MB/4.2GB	16X	2499

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Model	Size	View	Resolution	Price
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G70	17"	15.7"	1280 x 1024	739

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D141	133MHz	16MB/1.7GB	16X	999.00
L190	200MHz	16MB/2.0GB	16X	1399.99
2240X	200MHz MMX	32MB/3.2GB	16X	1899.99

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9710	166MHz MMX	16MB/2.1GB	8X	1799
9712	166MHz MMX	32MB/3.2GB	16X	1999

NEC Monitors

Model	Size	View	Resolution	Price
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Model	CPU	RAM/HD	CD	Price
7420	166MHz MMX	32MB/2.0GB	16X	\$1399
7125	133MHz	16MB/1.6GB	6X	899*
7320	166MHz MMX	16MB/2.1GB	16X	1399*
7360	200MHz MMX	32MB/3.8GB	16X	2199

* Factory Refurbished

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Model	Size	View	Resolution	Price
Pavilion	15"	13.8"	1024 x 768	\$449
Pavilion	17"	15.7"	1024 x 768	749

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HP Pavilion Multimedia

Pavilion 7420
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7130	133MHz	16MB/1.5GB	8X	1299
7160	166MHz	16MB/1.9GB	8X	1599
7161	166MHz MMX	32MB/2.4GB	12X	1699
7200	200MHz	16MB/3.0GB	8X	1949

Infinia Monitors

Model	Size	View	Resolution	Price
Infinia	15"	13.78"	1280 x 1024	\$459
Infinia	17"	16.23"	1280 x 1024	759



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Infinia Monitor
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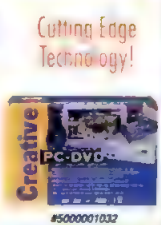
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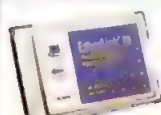
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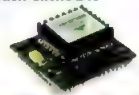
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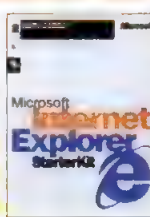
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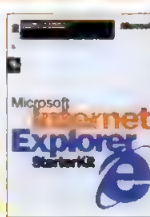
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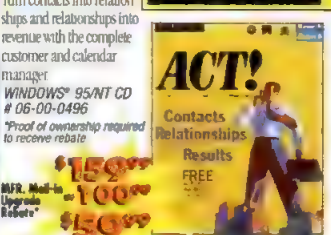
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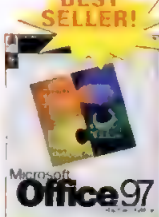
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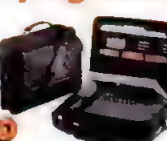
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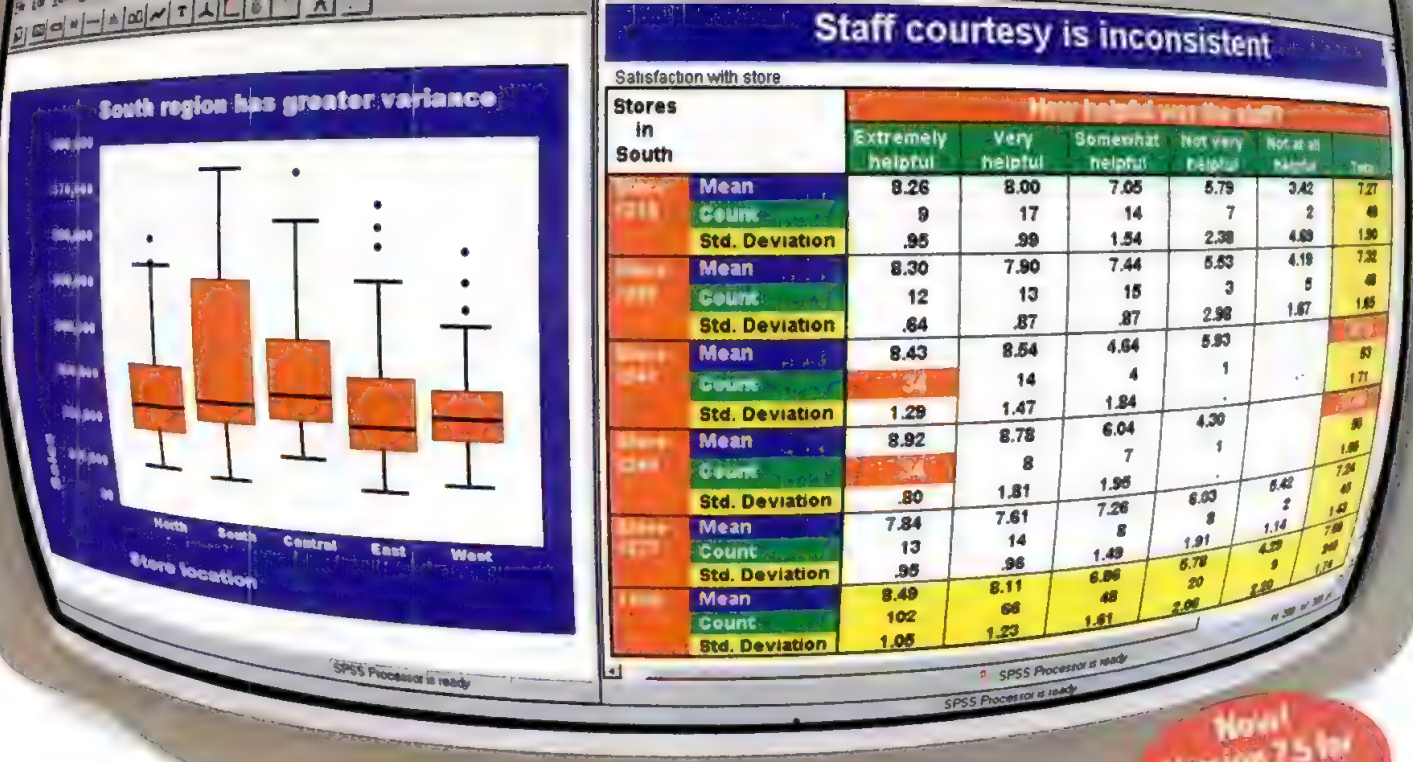
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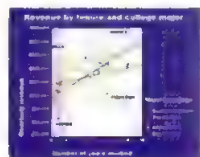
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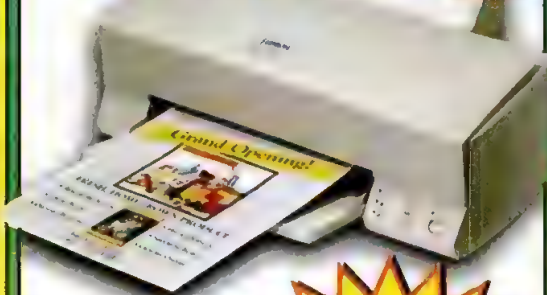
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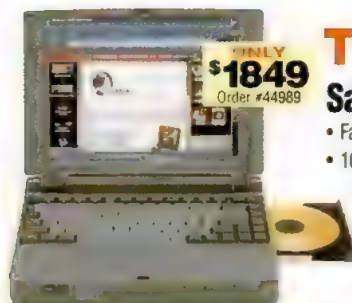
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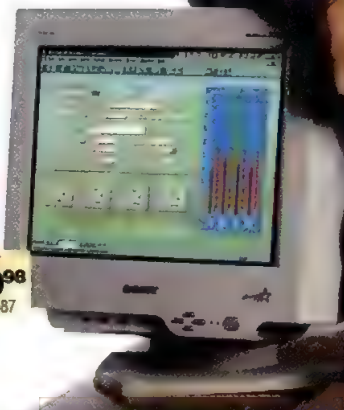
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NEC MultiSync XV17+	15.6	1280x1024	0.28	Star, NUTEK, IPM	82818	\$649.98
Sony Multiscan 200sf	16	1024x768	0.25	EPA/MPR II/Nutek	06687	\$729.98
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ViewSonic GT800 SonicTron	19.1	1600x1200	0.3	FCC/MPR II	87295	\$1,189.00
Sony Multiscan 20sfll	19.1	1280x1024	0.25	EPA/MPR II/Nutek	06678	\$1,199.00
ViewSonic P810	20	1600x1280	0.25	FCC/MPR II	84136	\$1,399.00
ViewSonic P815	20	1800x1440	0.25	FCC/MPR II	84170	\$1,599.00
Eizo FlexScan FX-E7	18.9	1600x1200	0.28	MRP II/TCO 95	43934	\$1,679.00
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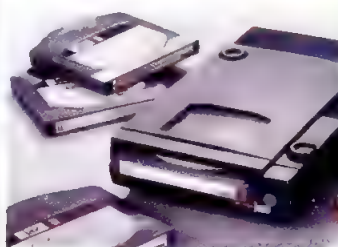
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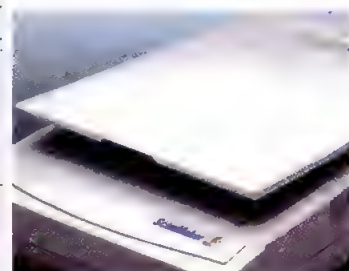
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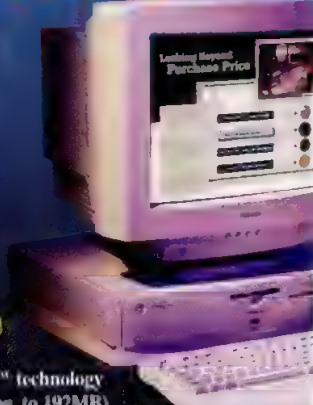
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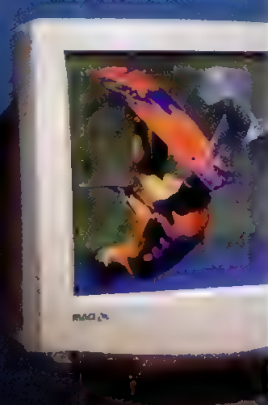
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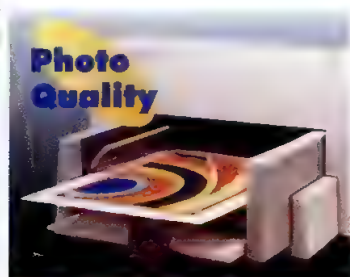
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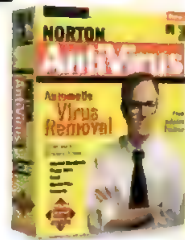
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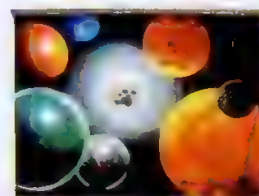
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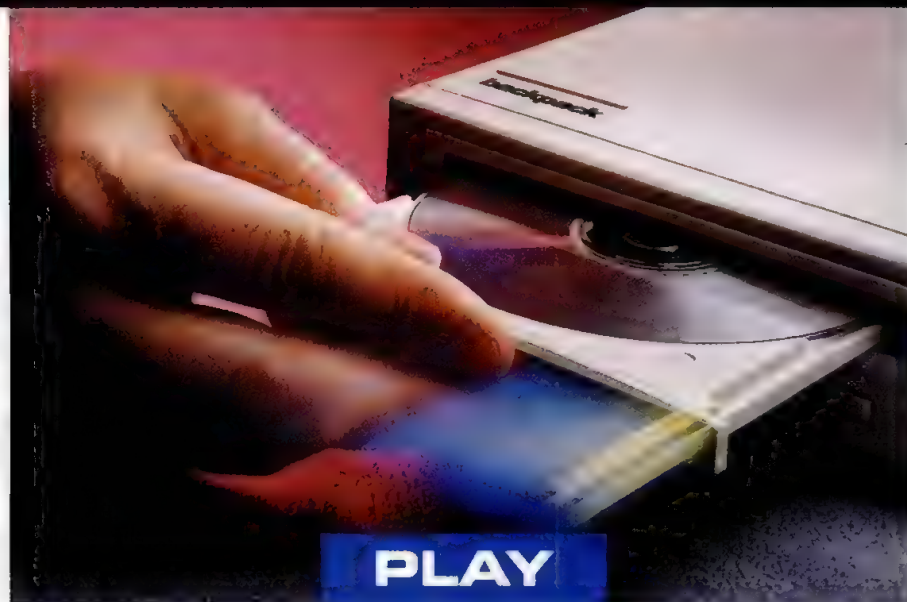
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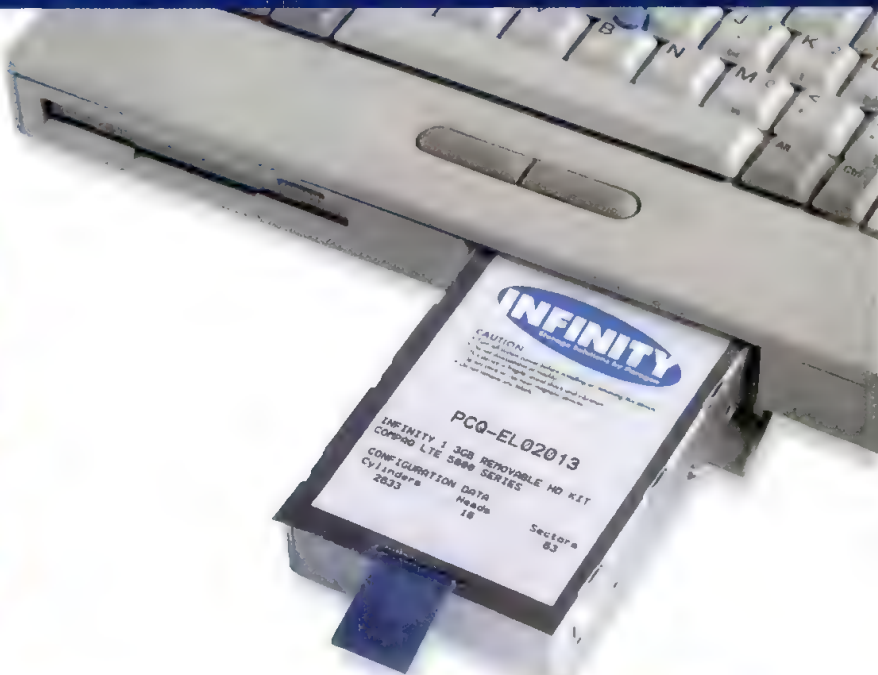
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ARMADA 1100, 4100 FAMILY	PCQ-AP02014	PCQ-AP02021	PCQ-AP02030
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SATELLITE 14900, 14800, 14650	PTS-TS01014	PTS-TS01021	PTS-TS01030
SATELLITE 14900, 12450, 12400	PTS-ATA02014	PTS-ATA02021	PTS-ATA02030
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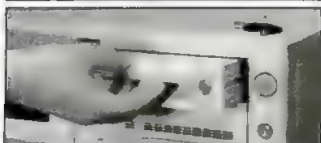
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IDE	RPM	Brand	Model	Price
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1275MB	4500	Seagate	ST31276A	\$185
1280MB	4500	Quantum	TM31280A	\$186
1281MB	5200	Western Digital	AC11200	\$181
1300MB	4200	JTS	JTS1300	\$169
1624MB	5200	Western Digital	AC21600	\$199
1670MB	4400	Maxtor	M81750A	\$195
1700MB 1400		Fujitsu	M1623T	\$180
1700MB	4500	Seagate	ST31720A	\$190
2100MB	4103	JTS	JTS2000	\$188
2100MB	4400	Fujitsu	M1624T	\$213
2100MB	5200	Western Digital	AC22100	\$209
2137MB	4500	Seagate	ST32132A	\$203
2151MB	5400	Quantum	FB32160A	\$221
2168MB	4500	Quantum	TM32160A	\$219
2187MB	4400	Maxtor	M82187A	\$218
2500MB	3600	Quantum	BF2500A	\$215
2500MB 5400		Fujitsu	M1635T	\$215
2559MB	5200	Western Digital	AC22500	\$226
2560MB	5400	Seagate	ST2520A	\$219
2560MB	4400	Maxtor	M82560A	\$219
2564MB	4500	Quantum	TM2550A	\$235
3168MB	5200	Western Digital	AC33100	\$248
3216MB	4500	Quantum	FB32160A	\$270
3228MB	5400	Quantum	FB32240A	\$270
3245MB	4500	Seagate	ST32450A	\$278
3500MB	4480	Maxtor	M83500A	\$292
3860MB 4500		Quantum	TM33840A	\$343
4000MB	5200	Western Digital	AC3400A	\$322
4310MB	5400	Quantum	FB4320A	\$360
4326MB	4500	Seagate	ST43240A	\$341
4335MB	3600	Quantum	BF4335A	\$239
5120MB 5400		Maxtor	M85120A	\$400
6448MB	4000	Quantum	FB6448A	\$535
6450MB	5400	Seagate	ST6450A	\$541
6510MB	3600	Quantum	BF6510A	\$369

SCSI HARD DRIVES

Add an Adaptec A2940U or PCI Ultra SCSI controller \$249

SCSI	RPM	Brand	Model	Price
1050MB	5400	Seagate	ST31055N	\$275
1200MB	4500	Quantum	TM31200S	\$229
2110MB	4500	Quantum	TM32110S	\$290
2150MB	5400	Seagate	ST2150N	\$355
2150MB	7200	Seagate	ST32171N	\$548
2151MB	5400	Quantum	FB32160S	\$330
3228MB	5400	Quantum	FB32240S	\$380
3254MB	4500	Quantum	TM33200S	\$348
4100MB 7200		Micropolis	MC4341	\$689
4310MB	5400	Quantum	FB4320S	\$479
4350MB	7200	Seagate	ST4371N	\$835
4400MB	7200	Fujitsu	M2954S	\$729
4550MB	7200	Micropolis	MC4345S	\$729
4550MB	7200	Micropolis	MC4345AS	\$819
4550MB	7200	Quantum	XP34550S	\$795
4550MB	10,000	Seagate	ST45501N	\$1049
4550MB	14,000	Quantum	FB45501N	\$599
9010MB 7200		Micropolis	MC4391	\$1239
9010MB	7200	Fujitsu	M2949S	\$1269
9100MB	7200	Quantum	XP39100S	\$1299
9100MB	7200	Micropolis	MC3911AV	\$1339
9100MB	7200	Seagate	ST19171N	\$1689
9100MB	10,000	Seagate	ST19101N	\$3379
23300MB	5400	Seagate	ST423451N	\$3809

WIDE HARD DRIVES

Add an Adaptec A2940U or PCI Ultra SCSI controller \$280

WIDE	RPM	Brand	Model	Price
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2149MB	5411	Seagate	ST32155W	\$497
2150MB	7200	Seagate	ST32171W	\$599
4294MB 7200		Micropolis	MC3243W	\$729
4294MB	7200	Micropolis	MC3243WAV	\$789
4550MB	7200	Seagate	ST34371W	\$899
4400MB	7200	Fujitsu	M2954W	\$749
4550MB	7200	Micropolis	MC4345W	\$789
4550MB	7200	Micropolis	MC4345WAV	\$849
4550MB	7200	Quantum	XP34550W	\$819
4550MB	10,000	Seagate	ST45501W	\$1109
9010MB 5400		Micropolis	MC3911W	\$1299
9010MB	5400	Micropolis	MC3911WAV	\$1399
9100MB	7200	Quantum	XP39100W	\$1329
9100MB	7200	Seagate	ST19171W	\$1789
9100MB	10,000	Seagate	ST19101W	\$3479
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IDE CD ROM	Speed	Brand	Model	ms	Int
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12X		Mitsumi	CRMCF12X	150	\$110
12X		Toshiba	XM5702B	115	\$101
16X		Lite On	LTN262A	120	\$105
16X		Mitsumi	CRMCF16X	120	\$111
16X		Acer	AC706A	120	\$109
16X		NEC	CDR150A	100	\$125
18X		Toshiba	XM6002II	90	\$120
18X		Acer	AC616A	120	\$135
IDE CD CHANGERS	Speed	Brand	Model	# Disks	Int
6X		NEC	CDR4X6	4	\$99
8X		NEC	CDR4X8	4	\$139

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SCSI CD ROM	Speed	Brand	Model	ms	Int
12X		Toshiba	XM5701B	115	\$169
12X		Plexstor	PK12TS(tray)	105	\$219
12X		Plexstor	PK12CS(caddy)	105	\$259
15X		Toshiba	XM3801B	99	\$219
16X		NEC	CDR1610	100	\$199
20X		Plexstor	PK20TS	95	\$239

SCSI CD CHANGERS	Speed	Brand	Model	# Disks
8X		Nakamichi	MJ48S	4 \$229
4X		Pioneer	DRM624X	6 \$399

SCSI CD TOWERS	Speed	Brand	Model	4 Drive	7 Drive
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4550MB	10,000	Seagate	ST34501WC	\$1179
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72-144Cig	DOS-5 DAT, 120MB/min	C5648A		\$3099
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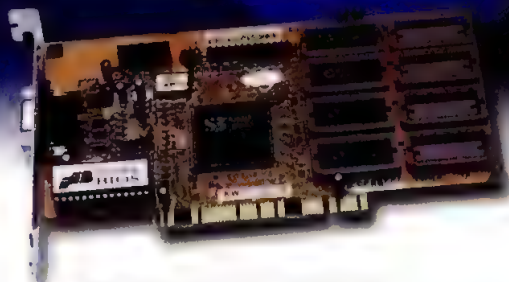
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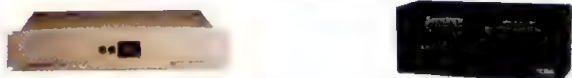
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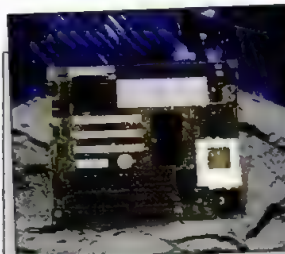
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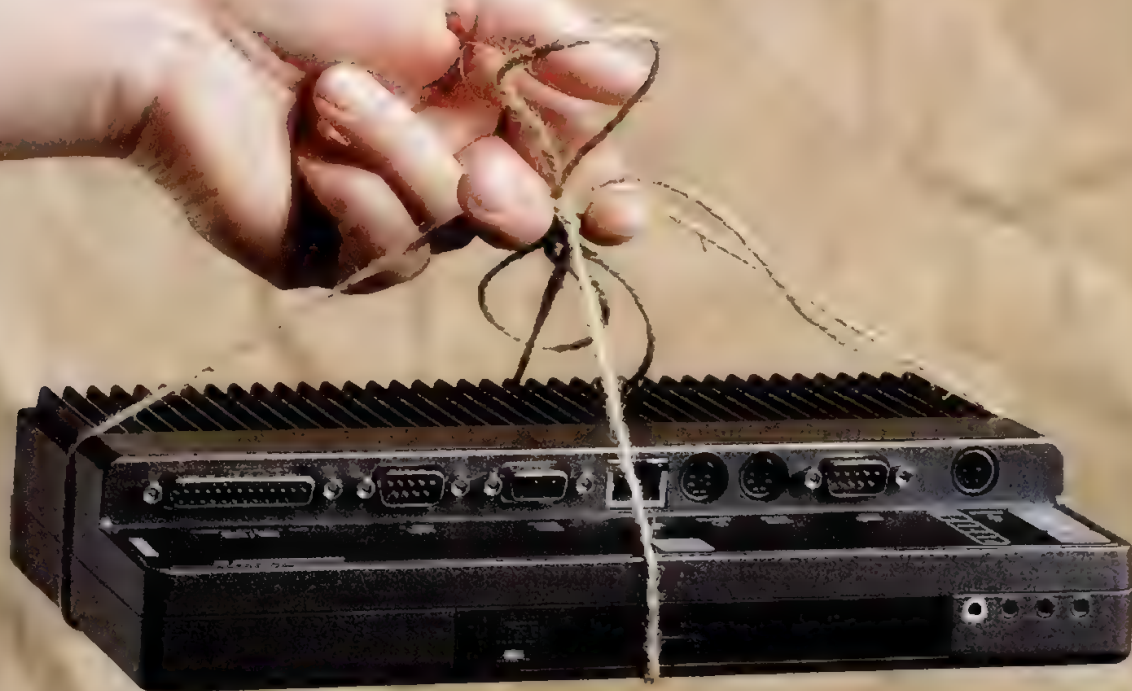
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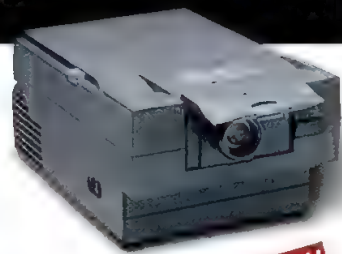
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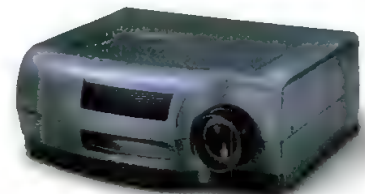
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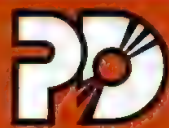
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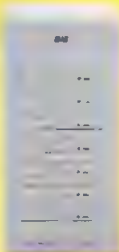
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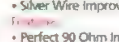
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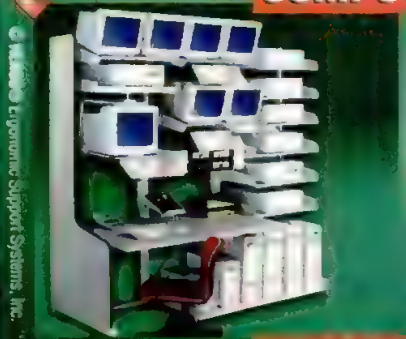
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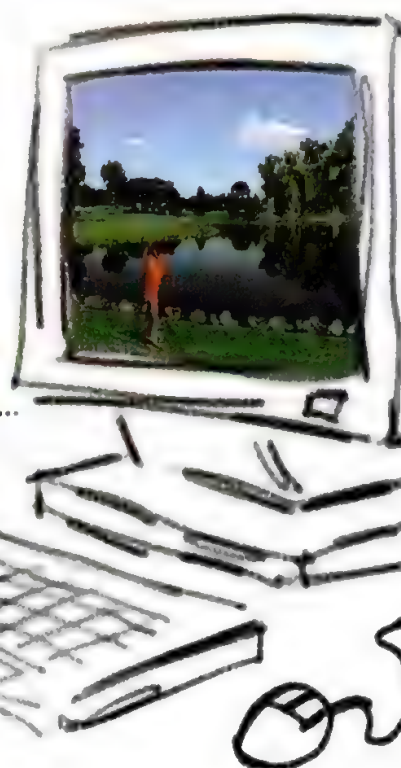
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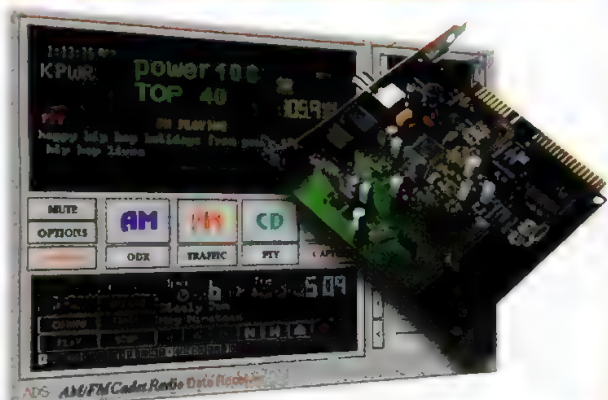


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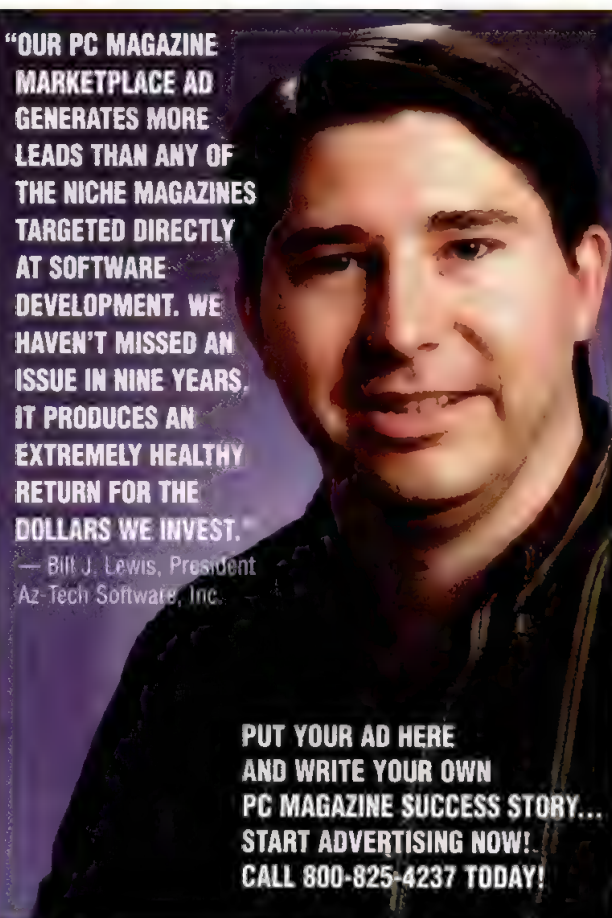
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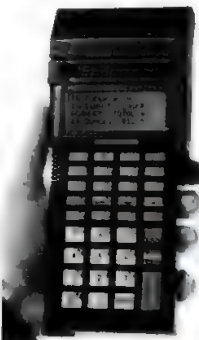
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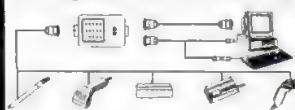
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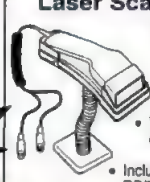
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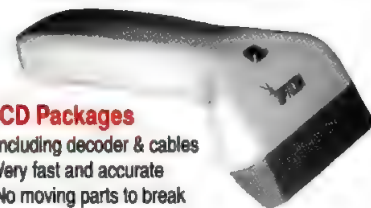
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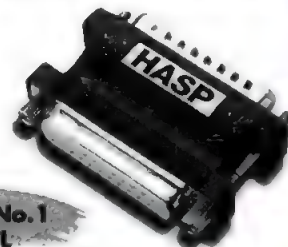
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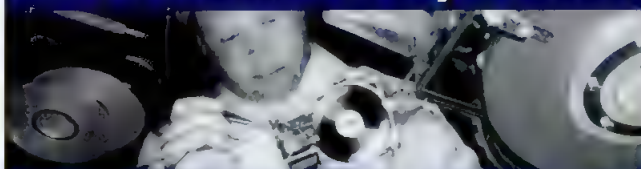
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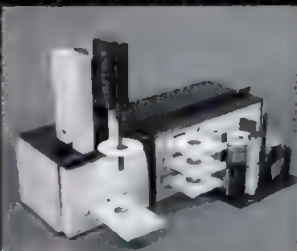
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After Hours

The New Sheriff in Town

LucasArts' new action game is daring and different from the rest.

Outlaws

They murdered your wife, kidnapped your daughter, and ruined your life. Now it's time to ruin theirs. This is the story behind LucasArts' Outlaws, a Wild West action game that provides a rich, unique first-person gaming experience that would make Sergio Leone proud.

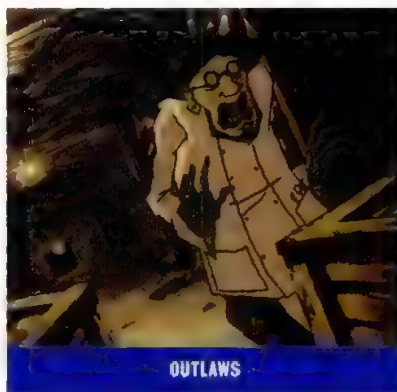
Outlaws is a Windows 95 game that requires a Pentium/60 with 16MB of RAM (or a Pentium/90 for multiplayer mode). The game tends to get sluggish, though, so we recommend at least a Pentium/133.

As Outlaws opens, a beautifully animated cut-scene sets the story in motion. You play James Anderson, a former U.S. marshall who now lives a quiet life with his wife and daughter.

Quiet, that is, until an evil railroad baron sends his overzealous goons who, instead of merely running you off your land, kill your wife and take your daughter. Enraged, you set out to rescue her and to exact vengeance.

You must fight your way through nine levels, including a train, an old mill, an abandoned mine, and a heavily guarded ranch. There aren't many levels in Outlaws, but each is challenging and well designed. For more single-player action, you can go through five additional Historical Missions. The art for all levels is impressive, despite the fact that the game uses the somewhat dated and sometimes quirky Dark Forces graphics engine.

As you might expect, each



level is filled with gun-toting brutes. These plain-looking, dim-witted villains fit the theme well, and we love the taunts they hurl at you.

The boss villains at the end of each level are far more formidable and can take you out with one or two shots. Sometimes these bosses blend in too well with the basic villains, especially in dark rooms. Since the level ends abruptly when you take out a boss, the game would be even better if bosses stood out from the riffraff.

What sets Outlaws apart from other action games is that you can't just run around the levels at top speed blowing everyone away: You need to duck behind barrels and line up long-range shots with the rifle scope (the coolest feature of the game). Most important, you need to reload periodically. Be warned: Die-hard Duke Nukem 3D and Quake fans looking for more of the same will not find it here.

Outlaws offers excellent multiplayer options: two play-

ers over modem and direct serial links, eight over a LAN, and four over the Internet. We spent most of our time in online shoot-outs in Microsoft's Internet Gaming Zone. Outlaws offers four different multiplayer

er modes, including the hilarious Kill the Fool with the Chicken mode.

Finally, we have to mention Outlaw's brilliant musical score, which is composed by LucasArts' Clint Bakajian. The dramatic, spaghetti western-style music is simply the best computer game sound track ever.

If you're looking for the next Quake, you won't find it in Outlaws, but you will find a challenging, well-designed, and highly entertaining game.

—Michael E. Ryan

INSIDE

Start your engines

Get behind the wheel in these four racing games. Page 420.



The Last Express

Mystery awaits you aboard this unusual adventure game. Page 424.

Heavy metal

The tank simulation game makes a triumphant comeback. Page 424.



THE POWER REVOLUTIONARIES
INTERVIEW

DIVA LA REVOLUCIÓN



Tomb Raider's fiery Lara Croft is one of the most recognized figures of the PowerVR™ Revolution. A confrontationalist, she has grown tired of the old 3D Order. With passion and anger, LARA has been relentlessly fanning the flames of revolutionary justice for gamers around the world.

WELCOME TO THE MOVEMENT. APPARENTLY, DISCOVERING ANCIENT TOMBS HAS FAILED TO SATISFY THE RADICAL HUNGERS THAT GNAW AT YOUR SOUL?

Lara Croft: My first passion will always be exploring ancient civilizations. But when I realized gamers were being kept down by inferior 3D technology, I went ballistic. I'm busting my arse to get gamers the 3D experience they deserve.

SO THE BLAND 3D EXPERIENCE WAS BOUND TO PRODUCE A REVOLT?

L: Absolutely. But this is an armed struggle, love. And the weapon is not the Colt .45 in my hand. It's the PowerVR 3D technology that will topple the bloody awful 3D experience.

ARE YOU SAYING EVERYTHING ABOUT CONVENTIONAL 3D TECHNOLOGIES DESERVES TO PERISH—SHOVED OFF TO THE ASH HEAP OF OBSOLESCENCE?

L: Bloody right, mate. Gamers want 3D technology that liberates their experience. Like higher resolution. Higher frame rates. Effects that take them as close to reality as you can get.

LIBERATION SEEMS TO BE A CENTRAL THEME DRIVING THE MOVEMENT.

L: Look, if I could escape the suffocating arrogance of snooty British society, gamers could overthrow the forces trying to smash the PowerVR resistance. That's what pumps adrenaline through my body.

UM, DON'T TAKE THIS THE WRONG WAY LARA, BUT THAT'S SOME BODY.

L: Actually, you should see it at 800x600 resolution. I think you'd dig my aerial flips with realistic shadows.

WHEW, WELL, UH...SO LARA, THESE ARE EXCITING, TURBULENT TIMES. GAMERS AND GAME DEVELOPERS SEEM TO BE GETTING SWEEPED UP IN THE PROMISE OF POWERVR.

L: That's right. Our freedom fighters are developing games right now that are PowerVR Ready. Eidos, Kalisto, Shiny, Sega Entertainment, FASA, Activision, Core Design, Gremlin. All feverishly churning out PowerVR Ready titles, including my next adventure, Tomb Raider 2.

WOULD YOU SAY THE MOVEMENT IS OBSESSED WITH POWER?

L: Of course, you twit. Frankly, we're not stopping until we have profoundly altered 3D reality for all gamers. And we will! Because we have finally seized the ultimate apparatus of real 3D power.

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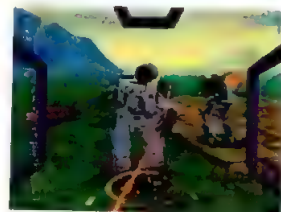
L: Yes. And with it, there will be no obstacles that can stand in the way of the mission of the PowerVR revolution: to produce the most realistic game experience imaginable. Now bugger off, I've got a battle to fight.



Tomb Raider



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After Hours

A Day at the Races

We put four arcade racing games through their paces and pick a winner.

Sometimes you just need to act on those (often violent) rush-hour impulses. Lucky for you, there are several arcade racing games available that allow you to take out your traffic-induced aggression without danger. We examined four recently released racing titles and awarded our Editors' Choice to The Need for Speed II.

We tested each of these games with game pads and the Thrustmaster Formula T2 steering wheel. As much as we like the T2, we feel that these games are far easier to control with a game pad.



The Need for Speed II



The sound of high-speed racing often fills the air at PC Labs now that we have The Need for Speed II, from Electronic Arts. This game is everything its predecessor, The Need for Speed SE, was—and then some.

You'll need a Pentium/90 with 16MB RAM to run this Windows 95 game. Electronic Arts recommends a Pentium/166, but our test ma-

chine, a Pentium/133, ran the game beautifully.

Just as the original Need for Speed games did, this one challenges you with several exotic supercars on a variety of tracks. You get to drive eight different cars on six tracks. Try the Ford GT90 for a thrilling ride, or drive a Lotus GTI through the ruins of Greece. If you're a good enough driver, you can earn access to a bonus track.

The cars are slick performance machines that can be customized to fit the track conditions, so it's best to check out each course before entering a

tournament. The courses, like the cars, are amazingly detailed, putting the game in a graphical league of its own.

For multiplayer action, you can fire up The Need for Speed II over network, modem, and direct serial links, as well as in split-screen mode.

The Need for Speed II is way ahead of the rest of the pack. And most important, it's the most fun to play. What more could you need (besides speed)?—*John Delaney*

Sega Rally Championship

Sega Entertainment's Sega Rally Championship looks and plays like most of the Sega games you'll find on consoles and in the arcade. Unfortunately, that familiar look and feel loses something on a PC monitor.

This Windows 95 game requires a Pentium/75 or faster with 16MB of RAM, though

we recommend at least a Pentium/120.

Sega Rally Championship offers you a choice of three regular courses and four vehicles. A bonus track and two bonus vehicles are also available at certain points in the game. The courses include



desert, forest, and mountain terrain. Start out on the easier desert track and work your way up to the mountain track, the hardest to navigate. You can customize each car's steering, tires, and suspension, and you can choose between manual and automatic transmissions. However, no matter how we configured the cars, we found them difficult to drive without spinning out or swerving all over the road.

Sega Rally Championship offers multiplayer support but will accommodate only two players via network, modem, or direct serial links. Split-screen mode is available for two players on the same PC.

Sega Rally Championship is easy to install. It has good sound effects, and the scenery is above average. Perhaps future versions will enhance the multiplayer features and improve the car handling to make this game a contender.—*JD*

Test Drive Off-Road

Jump behind the wheel of Test Drive Off-Road, the latest release from Accolade, and you're off on a wild and bumpy ride through some of the toughest terrain you could ever imagine.

This DOS and Windows 95 game requires a Pentium/90 with 16MB of RAM but will work best with a more powerful system. We recommend at least a Pentium/166.

Test Drive Off-Road's 12 racing tracks take you through desert, forest, and snow terrains. You can choose to drive a Jeep Wrangler, a Chevy K-1500, a Land Rover 90, or a status symbol of the nineties—the Hummer.

Each vehicle has its own power and handling characteristics and is a blast to drive.

You have to qualify on each course in order to unlock the next. If you're aggressive and can find a few shortcuts, you'll advance quickly through the courses (and find four bonus vehicles).

Test Drive Off-Road offers



multiplayer racing for up to four people using a network, and for two people using modem, split-screen, or direct serial mode.

If you're into off-road driving, Test Drive Off-Road is the game for you.—*JD*

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After Hours

Screamer 2

Virgin Interactive Entertainment's *Screamer 2* delivers exciting head-to-head, high-speed, road-racing action. But agility rather than speed is the deciding factor in this game. By adapting your vehicle and driving style to the different tracks, you can find yourself in the winner's circle.

Screamer 2 runs on DOS and Windows 95 and requires a Pentium/90 with 16MB of RAM. This game is more

graphics-intensive than the others reviewed here, however, so

we recommend a **Pentium/133**
or better.

Before you begin racing, you choose to join one of four teams. Each team has a different driving style, which makes navigating the course much

harder. Select one of six different courses with varying terrain and conditions. This is where customizing your vehicle is key: Driving through the ice and snow of Finland requires different tires than racing through the sand and dust in Egypt. Car selection is limited to four vehicles initially, with bonus cars available if you win a championship. Race against the Screamer 2 opponents or go head to head against your friends in split-screen, modem, or network play.

Screamer 2 combines quality graphics and exotic scenery with a mission to uncover bonus cars and tracks. Not as much high excitement as The Need for Speed II or Test Drive Off-Road, but an entertaining game nonetheless.—JD



QUICK CLIPS

Beavis and Butt-head in Screen Wreckers



 This lame collection of time-killing activities and screen savers is for hard-core Beavis and Butt-head fans only. Except for one funny game (Cornholio), this is just about the most useless CD-ROM we've ever seen. \$20 street; Viacom NewMedia. 800-469-2539. www.viacomnewmedia.com.



The Crow: City of Angels



 A noble but failed effort, this action game attempts to be part Tomb Raider and part Virtual Fighter but succeeds at neither. Instead, you get a confusing, buggy game with repetitive game play. The decent graphics don't save the game. \$49.95 list; Acclaim Entertainment Inc., 800-759-7800, www.acclaimnation.com.

Ten Pin Alley



 If you're into bowling, you might want to check this one out. Nicely rendered 3-D bowlers and humorous outtakes spice up a fairly challenging game. You can even play over the Internet and set up 30-player leagues—but of course, you won't get all the exercise you would from the real thing. \$30 street; ASC Games, 203-655-0032, www.ascgames.com.

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A Real-Time Whodunit

Twists and tensions abound in Broderbund's The Last Express.

The Last Express

Those hopping aboard The Last Express expecting a typical trip through adventure gaming are in for quite a different sort of ride. Played from both first- and third-person viewpoints, The Last Express is a compelling real-time whodunit that is much more than the usual tale of murder and intrigue aboard that famous train from Paris to Constantinople circa 1914. The game's point-and-click interface will no doubt seem familiar to adventure-gaming fans, but the Art Nouveau-style animation and time-sensitive game play are decidedly different.

The Last Express runs on DOS and requires a 486/66 with 8MB of RAM. The Windows 95 version requires a Pentium/60 with 8MB of RAM.

You are cast in the role of Robert Cath, a young American who receives a letter from Tyler Whitney, a friend. This letter urges you to join Tyler aboard the Orient Express. After a bit of motorcycle deriding-do, you make it onto the train to find that Tyler has been brutally murdered in his compartment. Once you dispose of the body (you don't want to be accused of murder, do you?) you don blood-free duds, assume Whitney's identity, and head out to find his killer.

You move around the game's four train cars in Myst-like fashion, using directional arrows. As you roam about, you admire the turn-of-the-century

settings, talk to potential suspects, and try to figure out how to get into other people's compartments.

Unlike staid adventure games that wait for you to act, The Last Express takes place in real time, with the action going on even if you aren't there

to see it. Since you're given only so much time to accomplish certain tasks, you have to hurry or you may find that this really will be the last express. There are even times when you'll have to fight to stay alive.

The Last Express is enjoyable, though not quite as entertaining as The Neverhood Chronicles or Full Throttle. Some players are sure to be put off by the lack of inventory-

driven puzzles. Still, the game serves up a taut murder mystery with plenty of unique features.—Shane Mooney



Worthy Successor

Finally, a good game of armored combat that tank fanatics can truly enjoy.

iM1A2 Abrams

Interactive Magic's iM1A2 Abrams is a quality tank simulation—a niche that has remained vacant since Microprose released M1 Tank Platoon in 1989. While the game's spartan graphics and complex controls take some getting used to, once you're over that hurdle, you're in for

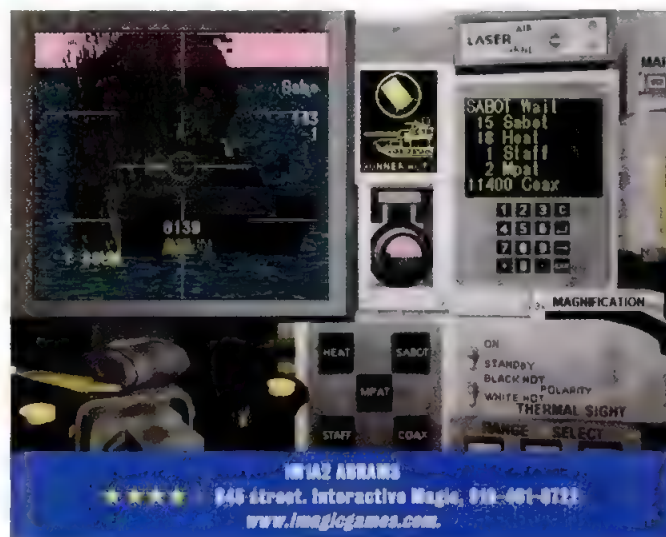
tank action that games like Armored Fist, Across The Rhine, and Tank Commander never offered.

iM1A2 Abrams is a Windows 95 game that requires a Pentium/90 with 16MB of RAM. To run the game with all of the detail settings active, however, you'll want a Pentium/133 or better.

The game offers quick-start arcade missions for fast action, single missions with more depth, and complete campaigns in Bosnia, the Gulf, and Ukraine. If you want high-level control, you can choose just what support units you take into each battle. The result is a game that allows you to determine the tactical approach to a battle, then switch to any of your M1A2s and take over as driver, gunner, or commander.

iM1A2 Abrams's 3-D graphics aren't likely to impress players used to Quake and Longbow. Almost everything else that matters is here, however, including cooperative and competitive network play (IPX and spotty TCP/IP). There are also instructions and an elaborate interface for Internet play, but it was completely nonfunctional as of this writing.

Features that iM1A2 Abrams lacks include the ability to select individual crew members and to give out promotions and medals. But on the whole, this is the tank game we've been waiting for.—T. Liam McDonald



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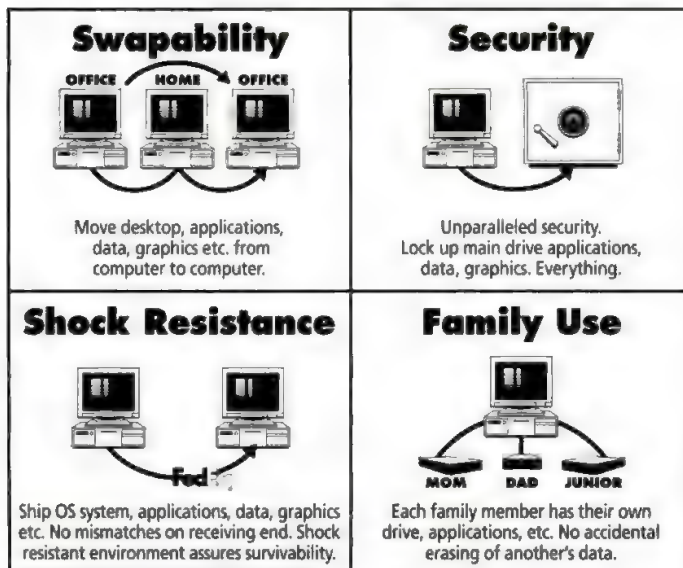
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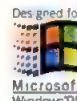
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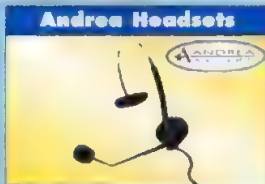
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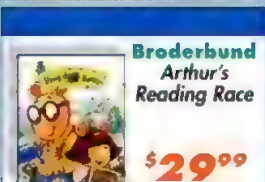
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Fellowes 2-Button PS/2 Desktop Mouse (FEL 99831)

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ENDS

Coming Up

What's in the Next Issue of *PC Magazine*

Portable PCs

Everyone wants to know which notebooks are the lightest or fastest or most powerful—and which are the best value. Here's our roundup of more than 60 notebook PCs. We're seeing bigger screens and models that are MMX-enabled.

Portable LCD Projectors

For the first time, we review 13 portable LCD projectors, each weighing less than 15 pounds. They're not cheap, but they're great for the professional out on the road doing presentations.

Information and Contact Managers

Ready to move over and manage your calendar and contacts electronically? Good timing. We review the whole market and recommend a PIM or contact manager that's just right for you.

Web Regional Guides

Where do you go on the Web to find the best restaurants in the city you'll be visiting next week? Here's our take on regional search sites and the best guides to several major cities.



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NE—Network Edition.

For information about the Network Edition of *PC Magazine*, call Circulation at 800-289-0429.

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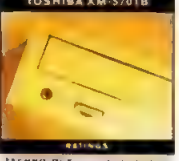
More Twisted Tales of Texas Travails

We've said it before, and we'll say it again: If you want a guaranteed laugh from the Web, look no farther than Walter Miller's Home Page (<http://pages.prodigy.com/Hell/walter/>). Now in its second year and still going strong, this diary of a well-meaning but hapless 20-year-old ex-felon forced to care for his abusive, not-quite-human, scatologically obsessed grandfather is consistently the funniest site on the Internet. It's Mark Twain writing on a bathroom wall. It's William Faulkner having a bad dream after drinking too much moonshine. It's a remake of *Alien* starring Jim Nabors. You won't be disappointed.

What's a Four-Letter Word For Computer?

Faithful reader Miriam Haber was doing the *New York Times* crossword puzzle on February 3 when she noticed that the clue for 2 Down was "perfect server." Was the answer Compaq or IBM or Hewlett-Packard? No, the four-letter answer was Acer.

All i2X CD-ROM Drives Are Not Equal

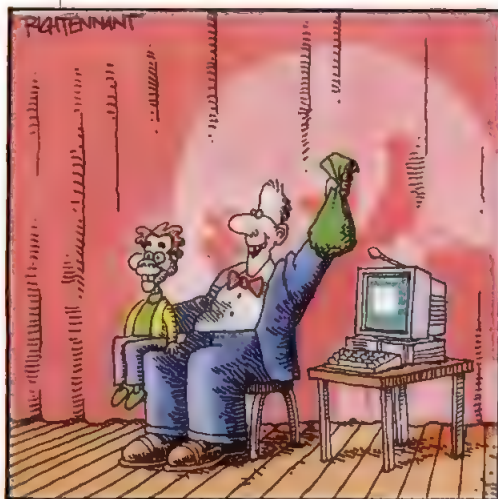
PIONEER DR-444	MITSUMI FX-120T
	
RATINGS	RATINGS
TECHNOLOGY	TECHNOLOGY
IMPLEMENTATION	IMPLEMENTATION
PERFORMANCE	PERFORMANCE
PLEXTOR 12PLEX PX-12CSJ	TOSHIBA RM-5701B
	
RATINGS	RATINGS
TECHNOLOGY	TECHNOLOGY
IMPLEMENTATION	IMPLEMENTATION
PERFORMANCE	PERFORMANCE

Read this Byte headline and then count the red stars. A contradiction, perhaps?

Aw, Lighten Up, Saddam!

Sometimes the Iraqi government is so serious. The Associated Press reported on an editorial from a leading Baghdad newspaper that said, "The Internet is one of the American means to enter every house in the world. They want to become the only source for controlling human beings in the new electronic village. It's the end of civilizations, cultures, interests, and ethics." Of course, there is no Internet access in Iraq, so what are they worried about?

Parsons Technology may want to reword this small portion of its online product catalog.



"For my finale, Rollo here will flawlessly activate my voice recognition system while I empty this bag of marbles into my mouth."

Hardware

Check out our line of unique hardware products, designed to maximize the time you spend with your computer.

If your entry is used, we'll send you \$50 and a *PC Magazine* T-shirt. Send your entries to Abort, Retry, Fail?, *PC Magazine*, One Park Ave., New York, NY 10016-5802 or via e-mail (text items only) to don_willmott@zd.com. Winners this issue: Claude Anderson, Juergen Haber, and Miriam Haber.

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NEW DELL DIMENSION XPS H266 266MHz PENTIUM II PROCESSOR	NEW DELL DIMENSION XPS M233s 233MHz PENTIUM PROCESSOR W/MMX	DELL DIMENSION XPS M200s 200MHz PENTIUM PROCESSOR W/MMX	DELL DIMENSION M166a 166MHz PENTIUM PROCESSOR W/MMX
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